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THE PHYSIOLOGICAL ACTIVE CONSTITUENTS OF CERTAIN PHILIPPINE MEDICINAL PLANTS: III

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ONE PLATE

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Berberine has been found in the following plants:

Berberis aquifolium.(1)
Jateorhiza palmata.(2)
Hydrastis canadensis.(3)
Menispermum canadense.(4)
Argemone mexicana.(5)
Coptis trifolia.(6)
Xanthoxylum americanum.(7)
Berberis asiatica.(8)
Berberis aristata.(8)
Berberis lycium.(8)
Podophyllum peltatum.(9)
Berberis vulgaris.(10)
Coptis tecta.(11)
Xanthoxylum clava-herculis.(12)
Coeloeline polycarpa.(13)
Caulophyllum thalictroides.(14)
Leontice thalictroides.(15)
Berberis aetnensis.(16)
Cocculus palmatus.(17)
Chelidonium majus.(18)
Stylaphorum diphyllum.(18)
Coscinium fenestratum.(19)
Xanthorriza apiifolia.(20)
Xanthoxylum senegalense.(21)
Thalictrum flavum.(22)
Ptelea trifoliata.(23)
Xylopia polycarpa.(24)
Geoffrayra inermis.(25)
Evodia glauca.(26)
Jeffersonia diphylla.(27)
Toddalia asiatica.(28)

ARCANGELISIA FLAVA (LINN.) MERR. (A. LEMNISCATA BECC.). MENISPERMACEAE

Philippine names: *Albustra, abutra* (Ilocano); *lagtal, lagtan, albotra* (Visayan); *lagtang, bute, ligtang, suma* (Tagalog); *suma* (Pampango).

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The names *albustra, abutra, albotra,* and *bute* are all corruptions of the Spanish-American name *abuta,* which was brought from Mexico by the Spaniards. These names are also applied to *Anamirta cocculus* W. & A. of the same family, which has much smaller fruits and white, *not yellow,* wood.

It is a coarse, woody vine, the stems up to 10 centimeters in diameter, with a characteristically yellow wood. The species is widely distributed in the Philippines, occurring in most, if not all, of the larger islands and provinces. However, it is local and widely scattered in thickets and forests, occurring especially on rocky slopes. No data as to its abundance were obtainable.

Chemical examination.—The soft porous wood was freed from the thin outer bark, finely ground while fresh, and macerated with 95 per cent ethyl alcohol. The solution resulting from this exhaustion was quickly evaporated under reduced pressure to one-fifth its volume; it was then cooled and salts made with hydrochloric, nitric, sulphuric, and hydriodic acids. A few grams of the pure alkaloid were obtained by an aqueous extraction of portions of the ground wood in a neutralized solution. Repeated extraction and evaporation with alcohol, and final crystallization from neutral ethyl acetate in a vacuum desiccator over calcium chloride, gave beautiful golden yellow crystals of the berberine base. When compounds of this nature are crystallized in a vacuum desiccator over sulphuric acid it is noticeable that traces of acid sulphates are formed. This was observed particularly when the acetone compound was placed in such a desiccator. The compound was identified as berberine.

Large quantities of salts of the alkaloid were easily crystallized out with nitric, sulphuric, and hydrochloric acids. Upon heating, the sulphate melts to a brown amorphous mass, slightly soluble in water; it has an intense yellow color and a bitter taste, is soluble in alcohol and in hot water, and is almost insoluble in ether and benzene. The solution allows precipitation with alkaloidal reagents and also with potassium iodide solution. In concentrated sulphuric acid it gives an olive green color; a fragment of sodium nitrate added to the sulphuric acid solution gives a characteristic violet color. The acetone compound was obtained by the method of acetone treating the sulphate of the compound in an alcoholic solution. The resultant compound, which is represented as $C_{20}H_{17}NO_4 \cdot C_3H_6O$, was also obtained by treating a hot solution of 50 grams of the crystalline berberine sulphate in 1 liter of water. Five hundred grams

of acetone were added to this solution; after mixing, it was made alkaline with sodium hydroxide. This is a method of Gaze.(29) A greenish yellow crystalline substance separates therefrom (see Plate I). The pure crystalline berberine obtained by the decomposition of the berberine acetone compound is dark golden brown, but it is slightly lightened in color by purification with alcohol.

Quantitative determinations made on the plant substance show approximately 4.8 per cent of pure alkaloid in the moisture-free material.

Combustion of the alkaloid, when freed from as much water of crystallization as is possible without apparent decomposition, gave the following results:

Determination No. 1.—0.15 gram of substance gave 0.0788 gram of water and 0.3876 gram of carbon dioxide.

Determination No. 2.—0.15 gram of substance gave 0.0771 gram of water and 0.3854 gram of carbon dioxide.

Theoretically, the combustion of water-free berberine gives carbon 71.64 per cent and hydrogen 5.07 per cent. Determination No. 1 shows carbon 70.47 per cent and hydrogen 5.84 per cent. Determination No. 2 shows carbon 70.47 per cent and hydrogen 5.63 per cent. Nitrogen found in the alkaloid amounted to 4.03 per cent.

Arcangelisia flava (Linn.) Merr. is believed to have a larger percentage of alkaloid than any other plant found in the Philippines; and, should the therapeutic value of berberine become very important, even a small plant for the recovery of this alkaloid would develop into a paying industry. The above calculations, together with the qualitative tests expressed, are sufficient to establish the presence of berberine in *Arcangelisia flava* (Linn.) Merr.

CASSIA SIMEA LAM. (LEGUMINOSAE)

In the Philippines this tree occurs in cultivation only. It is commonly planted as a shade tree in Manila and in other large towns of the Archipelago. It is known by its Spanish name *acacia,* which is also applied to other trees of the same family. *Cassia florida* Vahl is a synonym. I can find no record of the tree serving any other useful purpose in the Philippine Islands than that of giving shade.

A search of the literature revealed no record of any active principles found in this plant. However, a recent communication from Father Algue, director of the Philippine Weather

Bureau, states that the feeding of fresh branches and pods of this tree had caused the death of many of their hogs. For this reason a chemical analysis was made of the pods, branches, and leaves and the presence of a poisonous alkaloid established. 0.1015 gram of alkaloid gave 0.0725 gram of water and 0.2463 gram of carbon dioxide, which gave 7.93 per cent hydrogen and 66.18 per cent carbon; 0.1000 gram of alkaloid gave 0.0685 gram of water and 0.2385 gram of carbon dioxide, equal to 7.61 per cent of hydrogen and 65.04 per cent of carbon; 0.2016 gram of alkaloid gave 0.1415 gram of water and 0.4971 gram of carbon dioxide equal to 7.80 per cent of hydrogen and 67.25 per cent of carbon.

Percentages of carbon, hydrogen, and nitrogen in alkaloid from Cassia siamea.

	Carbon.	Hydrogen.	Nitrogen.
Sample 1	66.18	7.93	5.39
Sample 2	65.04	7.61	
Sample 3	67.25	7.80	5.60
Total	198.47	23.34	10.99
Average	66.16	7.78	5.495

These figures furnish data for an empirical formula for the alkaloid found in *Cassia siamea,* namely $C_{14}H_{19}NO_3$. With intraperitoneal injections of 1 cubic centimeter of a 5 per cent solution of the hydrochloride large guinea pigs readily exhibited symptoms of poisoning, usually resulting in death.

GEODORUM NUTANS AMES

Philippine names: *Camaog, lubi lubi* (Visayan); *cola* (Tagalog, from the Spanish word *cola,* meaning "glue").

This plant is a terrestrial orchid that is found in thickets and in uncultivated open lands at low altitudes throughout the Philippines, generally as scattered individuals, but occasionally abundant. Its only known use is that of an adhesive. The rhizomes are split and the pulp rubbed upon the surfaces to be glued. The plant is used throughout the Islands as a glue in the manufacture of stringed instruments. The water extraction of the plant gives a gum which is separated by precipitation with alcohol. This gum has exceptional strength and lasting power. The moisture content of the plant is 79.5 per cent. The yield of dry gum on the fresh plant is about 14 per cent, and on the moisture-free sample, 68.8 per cent.

No substances of therapeutic value were found.

CORIARIA INTERMEDIA MATSUMURA

This is the only representative of the small family Coriariaceae known from the Philippines and occurs at high altitudes in Mountain Province, Luzon; it is called *buacat* by the Igorots of Benguet, who claim that the fruit is inedible because it is poisonous. A glucoside is found to be present in very small quantities in the leaves and fruits of this plant. One hundred kilograms of the fresh plant give 69 grams of crude glucoside, which can be extracted by water or squeezed from the young shoots. The extract is treated in the usual manner with lead acetate, and the filtrate is freed from excess lead by hydrogen sulphide and evaporated to a sirup. From this the glucoside is extracted by alcohol and precipitated by ether.

Two cubic centimeters of plant extract, representing 20 grams of the fresh plant, intraperitoneally injected into a guinea pig weighing 700 grams, resulted in death after thirty minutes.

Coriaria is known in New Zealand as "toot-plant." Landsay (30) has the following to say regarding this plant:

> During a tour through the New Zealand provinces in 1861–1862, I was struck with the abundant evidences, which everywhere presented themselves, of the ravages produced among the flocks and herds of the settlers by the *Toot-plant*, one of the most common indigenous shrubs of these islands. In many cases of losses by individual settlers brought under his [their ?] notice, the amount of loss from this source alone had been from 25 to 75 per cent. In Otago, particularly, were such losses felt during the height of the gold mania there, from July to December, 1861: the traffic between Dunedin and Tuapeka gold-fields required the service of large numbers of bullocks, a great proportion of which were lost by Toot-poisoning. * * *
>
> 1. The Toot-poison belongs to the class of *Narcotico-irritants*. *a*. Its action on man includes the following symptoms:—coma, with or without delirium; sometimes great muscular excitement or convulsions; the details differing in different individuals; during convalescence, loss of memory, with or without vertigo. *b*. In cattle and sheep, they include vertigo, stupor, delirium, and convulsions; curious staggerings and gyrations; frantic kicking, and racing or coursing; tremors.
>
> 2. The poisonous portion of the plant, (*a*) to man, is generally the *Seed*, which is contained in a beautiful, dark-purple, luscious berry, resembling the blackberry, which clusters closely in rich pendent racemes, and which is most tempting to children; occasionally the young *Shoots* of the plant, as it grows up in spring: (*b*) to cattle and sheep, in almost all cases, is the young *Shoot*, which is tender and succulent, resembling in appearance and taste the similar state of Asparagus.

CONCLUSIONS

Arcangelisia flava (Linn.) Merr. (*A. lemniscata* Becc.) contains berberine and shows approximately 4.8 per cent of pure alkaloid based on moisture-free wood. The plant material is

soft and porous, and contains but small amounts of extractive matter that interferes in the recovery of the alkaloid. The recovery of the alkaloid is simple and inexpensive, showing the plant to be an excellent source of the drug.

Cassia siamea Lam. contains an alkaloid with the formula $C_{14}H_{19}NO_3$.

The rhizomes of *Geodorum nutans* Ames contain about 14 per cent of a water-soluble adhesive.

Coriaria intermedia Mats. contains a poisonous glucoside in its leaves and fruit.

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(14) Pommerehne, loc. cit.

(15) Mayer, F. F., *Journ. de Pharm. et de Chim.* (3) 46, 496. Some authors claim that *Leontice thalictroides* is identical with *Caulophyllum thalictroides.*

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(24) Stenhouse, *Pharm. Journ. Trans.* [3], **46**, 495.
(25) Gastel, Jahresbericht über die Forstchritte der Chemie und verwandter Theile andere Wissenschaften (1866), 480.
(26) Martin, *Pharm. Journ. Trans.* [3], **13**, 337.
(27) Gordin, loc. cit., contradicting Mayer.
(28) Brill and Wells, *Philip. Journ. Sci., Sec. A* (1917), **12**, 167.
(29) Gaze, *Arch. d. Pharm.* (1890), **No. 228**, 607.
(30) Landsay, W. Lauder, *Journ. Bot.* (1863), **1**, 247.

ILLUSTRATION

PLATE I

FIG. 1. Berberine-acetone compound. × 110.
2. Quick crystallization of the hydrochloride of the alkaloid.

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Fig. 1. Berberine-acetone compound.

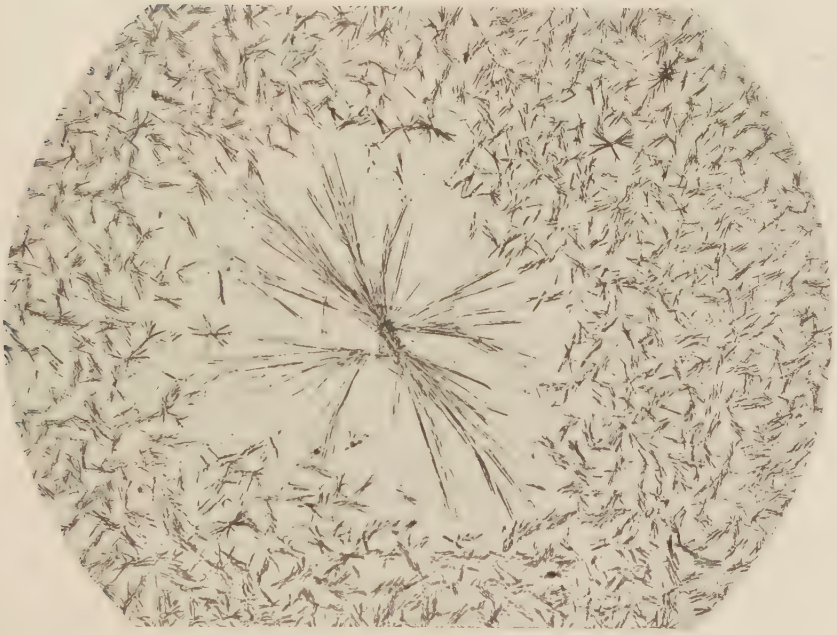

Fig. 2. Quick crystallization of the hydrochloride of the alkaloid.

PLATE I.

THE TREATMENT OF HUMAN BERIBERI WITH AUTOLYZED YEAST EXTRACT

By N. M. Saleeby

(*Manila*)

The extract of rice polishings has become recognized as one of the most efficient remedies for the treatment of infantile beriberi.[1] However, it does not markedly improve cases of long standing.

Williams and Saleeby[2] have shown that the hydrolyzed extract does have a prompt and decisive action on these more chronic cases, but that it must be administered only under the direct supervision of the physician on account of its poisonous qualities when given in excessive doses. These investigators believe that the poisonous nature of the hydrolyzed extract is due to the choline present.

That polyneuritis in fowls is improved by treatment with yeast has been known for some time.[3] Cooper found that no poisonous effects followed the daily dose of 30 cubic centimeters of autolyzed yeast extract to chickens and that the administration of 100 cubic centimeters did no harm.

In order that this extract might be tried on human beriberi, in 1917 and 1918 the Bureau of Science prepared and delivered to me in 50 cubic centimeter bottles an autolyzed yeast extract and requested me to try its efficacy when given to human patients. Brewers' yeast was obtained from the San Miguel and the Oriental breweries, of Manila, separated from the adhering beer and placed in an incubator at a temperature of 35° C. until it had assumed a mushlike consistency (about forty-eight hours) due to autolysis. The mass was then filtered through paper, washed on the filter, and the filtrate concentrated under a partial vacuum at a temperature below 60° C. to a volume of about one-third of the original.

[1] Albert, J., *Philip. Journ. Sci., Sec. B* (1915), 10, 81. The Bureau of Science, Manila, manufactures about 400 liters of this extract annually for use in the Philippines.

[2] Williams, R. R., and Saleeby, N. M., *Philip. Journ. Sci., Sec. B.* (1915), 10, 99.

[3] Cooper, E. A., *Bio-chem. Journ.* (1914), 8, 250.

A concise summary of my findings when the autolyzed yeast extract was given to human patients is as follows:

1. About two score cases were treated; five were children below 2 years of age; ten were treated in hospital; all others were out-patients.

2. Adults were given from 15 to 40 cubic centimeters three times a day. Children were given from 2 to 4 cubic centimeters every three hours, or six times a day. Bigger doses did not seem to give better results. No sign of poisoning was observed.

3. Only acute and uncomplicated symptoms of beriberi were observed under treatment. Chronic nerve, muscular, or cardiac lesions were actually unaffected.

5. All acute peripheral symptoms of neuritis were affected quickly. Marked results were noted in less than three days, and a week's treatment seemed to give full relief in mild acute cases. Treatment was generally followed up for two weeks at least.

6. Infantile-beriberi symptoms were relieved with comparative rapidity. Œdema yielded quickly, and nutrition improved at once.

7. No special diet was prescribed. Patients were given regular hospital diets in accordance with the state of their digestion.

8. Children receiving the extract continued to nurse at the mother's breast.

9. The effect of the autolyzed yeast extract used is similar to that produced by the hydrolyzed extract of rice polishings; it seemed weaker, however.

A PHOTOGRAPHIC STUDY OF LEPROSY[1]

By Oswald E. Denney

(Chief, Culion Leper Colony, Culion, P. I.)

FOUR PLATES

The great variety of typical lesions of leprosy has rendered it impracticable completely to illustrate the disease in the average textbook; it seemed desirable, therefore, to present a photographic study showing the progression of the external lesions.

The clinical manifestations of leprosy have been so fully described by the many students of the disease that discussion at length in the present paper is not necessary. The disease is generally considered to manifest itself in two distinct types—the "nodular" and the "maculo-anæsthetic." A combination of symptoms of these two is recognized as the "mixed" type. In this study the two principal types only will be considered; the mixed type, obviously, may present any composite picture of the nodular and maculo-anæsthetic types.

Since the manner of entrance into the body of the causative agent of the disease (*Mycobacterium lepræ*, or *Bacillus lepræ* Hansen) is unknown, the initial lesion cannot be demonstrated with certainty; however, the earliest recognized lesion can be illustrated (Plate I, figs. 1 to 9; and Plate II, figs. 10 to 15). The progression of the lesions of the nodular type as indicated in the above series may be reproduced in practically any part of the body.

The photographable manifestations of uncomplicated maculo-anæsthetic leprosy are mainly confined to the macules, which appear chiefly on the back and face, but which may appear on any part of the body; the deformities that result from motor-nerve destruction; and the trophic ulcers that result from disturbed nutrition. The deformities of uncomplicated maculo-anæsthetic leprosy in the hands are illustrated by Plate II, figs. 16 and 17; and Plate III, figs. 18 and 19.

Plate III, fig. 20, illustrates the typical perforating ulcer of the foot; this lesion is considered as diagnostic of leprosy by the natives in many parts of the world.

[1] Received for publication, September 6, 1918.

Plate III, fig. 21, illustrates the typical, sluggish, neurotrophic ulcers, which although almost incurable appear to have a strong resistance to the ordinary pyogenic infections. Here, too, is shown the curious parchmentlike skin frequently seen among anæsthetic lepers.

The macules of the maculo-anæsthetic type are reproduced with difficulty, particularly in the dark-skinned races, because of the lack of contrast (Plate III, figs. 22 to 25).

Another lesion of leprosy that, due to its great prevalence among the Filipino lepers, deserves special description is the condition of bone necrosis and absorption commonly seen in the feet and hands. The condition is generally described as of the maculo-anæsthetic type and is probably not entitled to classification as a special type. The condition may be seen rarely among the pure nodular types, commonly among the maculo-anæsthetic and mixed types, and occasionally among lepers who fail to show coincident evidence of progressive nodular or maculo-anæsthetic symptoms. The complete series of changes extends over a number of years and therefore may be followed with great difficulty in individual cases. The sequence appears to be much as shown in Plate IV, figs. 26 to 33.

The process of absorption as indicated above usually does not continue without complications from trauma and secondary infections; the bones being near the surface and unprotected by the normal connective tissue pads of the finger tips, sinuses frequently form, from which necrotic bone is discharged. An instance is recalled of a patient, since dead, in whom the five finger nails of one hand remained attached in a much distorted condition at the site of the radiocarpal articulation, the bones of the entire hand having been absorbed without rupture of the skin from trauma.

It is not to be inferred from this series of photographs that each case of leprosy progresses by rule to a definite classical physical picture; there is perhaps no disease so capricious in the manifestations of its clinical progress.

ILLUSTRATIONS

PLATE I

FIG. 1. A maculo-papular lesion of three years' duration on the cheek of a 6-year-old Filipina, which up to the present time is her only demonstrable lesion of leprosy. The spot, about 2 centimeters in diameter, is slightly elevated above the normal skin surface; it is pink and contains numerous small nodules in which the causative organism can be found. A lesion of this character may remain practically unchanged for years; may almost entirely disappear, leaving a pale or pigmented, smooth spot; or it may grow progressively larger with the coincident appearance elsewhere of similar spots, as in fig. 2.

2. Maculo-papular lesions of leprosy on each cheek and on the chin.

3. An apparent latency of the macules of leprosy; which, in this case, are neither elevated nor nodular, but are smooth and faintly pigmented and as such cannot be distinguished from the numerous tinea, etc., that are frequently met with in the tropics. In this and in the succeeding illustrations may be seen the progressive infiltration of the tissues over the inner half of the superciliary ridge, giving rise to overhanging eyebrows, suggesting a frown. Mention is frequently made of the loss of the hair of the outer half of the eyebrows as an early and diagnostic symptom of leprosy; this is not present in the cases shown in figs. 1 to 3.

4. A case of leprosy, relatively older than those of figs. 1 to 3, showing a thinning of the outer half of the eyebrows as well as the early nodular infiltration of the nasal alæ and the helix and lobule of each ear.

5. A somewhat more advanced case of leprosy with a nodular infiltration extending over the face. The nodules are small with the exception of one on the chin. Complete loss of the hair of the outer half of the eyebrows is here shown. A small amount of œdema of the eyelids is present.

6. The nodules are larger and more prominent than in the preceding cases. This and figs. 7 to 9 illustrate the loss of normal contour of the nose from the destruction of cartilaginous tissue.

7. In addition to the diffuse infiltration of the face, there are well-marked infiltration of the lips and slightly pendulous ear lobules.

8. The nodules, as discrete tumors, are surrounded by apparently normal tissue. A considerable loss of the cartilage of the tip of the nose has caused a marked flattening of this appendage.

9. Illustrating shotlike tubercles of leprosy as discrete nodules, scattered over the entire face; the arms and the legs, and to a lesser extent the trunk, showed similar tumors.

PLATE II

FIG. 10. Showing a not uncommon condition in leprosy, in which the nodules themselves undergo necrosis with subsequent absorption, leaving smooth cicatrices. Necrosis of the cartilage of the left ear and of one nodule on the left cheek is here in progress.

11. Showing the partial coalescence of large nodules on the cheeks and chin; this condition in advanced cases of leprosy gives rise to the leonine facies.

12. A profile view of a case of early leontiasis, showing a diffuse thickening of the skin of the face. This is an excellent example of pendulous ear lobules.

13. A slightly more advanced case of leontiasis, showing the loss of the normal lines of expression of the face, notably in the distorted lips.

14. A still farther advanced case of leontiasis; the general thickening of the tissues of the face has given rise to a "death-masklike" appearance. Leprous cachexia is well marked in this woman.

15. A fairly typical case of leontiasis. This may be considered as the terminal manifestation of uncomplicated nodular leprosy in the face.

16. A typical "ring and little finger deformity," the earliest recognizable deformity of this type of leprosy in the hands. Both fingers can be straightened with only moderate force and at this stage retain some function.

17. A moderate contraction in all the fingers in leprosy; both thumbs, in this case, appeared to be normal. At the instant the picture was being taken, a moderate pressure was being exerted on the fingers to show the approximate amount of available extension.

PLATE III

FIG. 18. A more nearly complete contraction of the fingers than in fig. 17; here, too, the limit of extension is shown. The œdema present in the fingers of the left hand is transient and is due to an infection in the palm of the hand.

19. An example of the claw hand of leprosy, the classical *main en griffe;* the typical atrophy of the interossei is indicated in the left hand. The condition of this hand may be considered as the terminal manifestation of anæsthetic leprosy of the hands in uncomplicated cases. Unfortunately, the disease rarely stops with this deformity. Due to the coincident anæsthesia, the hands are subject to trauma, particularly to burns, which may be very extensive and are usually painless. Other trauma and neurotrophic changes result in various deformities.

20. The typical perforating ulcer of the foot; this lesion is considered by the natives in many parts of the world as diagnostic of leprosy.

21. The typical, sluggish, neurotrophic ulcers of leprosy, which although almost incurable appear to have a strong resistance to the ordinary pyogenic infections. The curious parchmentlike skin frequently seen among anæsthetic lepers is shown.

FIG. 22. A single, large patch on the back of a leper having a slightly pigmented, rugged, central area and a slightly erythematous periphery.

23. An almost diffuse outcropping of small erythematous macules of leprosy, not unlike those of secondary syphilis.

24. The coalescence of numerous macules of leprosy, giving rise to curious circinate designs.

25. A somewhat unusual herpeslike series of macules of leprosy.

PLATE IV

FIG. 26. An undeformed hand, aside from the slight spindle shape of the fingers; the proximal portions being about normal in appearance, the distal phalanges being smaller and pointed.

27. An obviously deformed hand, the spindle shape being greatly exaggerated. Unquestionably in this case of leprosy the osseous tissues are not alone in the retrogressive process.

28. The process of absorption is in progress, and there is some distortion of the digits from coincident nerve involvement. The thumb of each hand in this case is unattacked.

29. A more advanced stage; in this case the nails may be seen in their deformed state almost at the point of articulation of the first and second phalanges.

30. The proximal phalanges are almost completely absorbed, the thumb of the right hand alone having escaped the process.

31. A similar irregularity in the absorption of the fingers, the middle finger of the left hand being unabsorbed.

32. The peculiar "telescoped" appearance occasionally seen, in which the process of absorption of the osseous tissue has proceeded more rapidly than that of the other tissues.

33. The partial absorption of the metacarpals of the left hand; the distorted finger nails remain as horny projections on the palmar aspect of the hand. The right hand shows a long scar at the site of the metacarpo-phalangeal articulation, the result of amputation of infected fingers. The left hand shows no scars since the skin has remained unbroken during the entire process.

Fig. 1. Fig. 2. Fig. 3.

Fig. 4. Fig. 5. Fig. 6.

Fig. 7. Fig. 8. Fig. 9.

PLATE I.

Fig. 10. Fig. 11. Fig. 12.

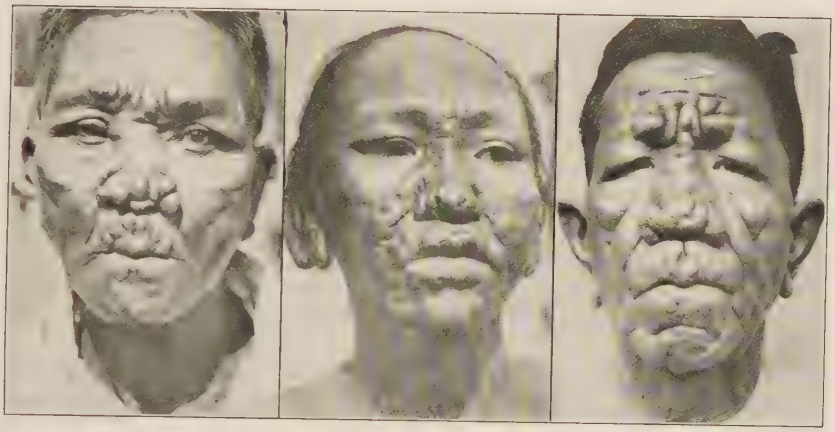

Fig. 13. Fig. 14. Fig. 15.

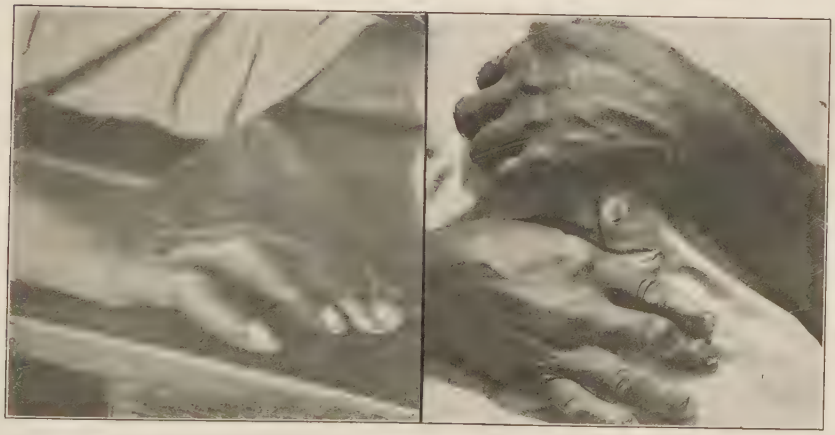

Fig. 16. Fig. 17.

PLATE II.

Fig. 18.

Fig. 19.

Fig. 20.

Fig. 21.

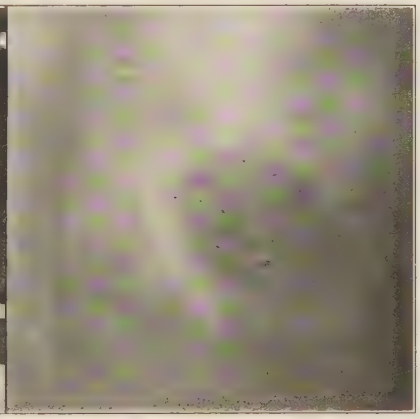

Fig. 22.

Fig. 23.

Fig. 24.

Fig. 25.

PLATE III.

Fig. 26.

Fig. 27.

Fig. 28.

Fig. 29.

Fig. 30.

Fig. 31.

Fig. 32.

Fig. 33.

PLATE IV.

A COMPARATIVE STUDY OF DIFFERENT METHODS OF TREATMENT OF TYPHOID FEVER [1]

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TEN TEXT FIGURES

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INTRODUCTION

Life is short and art long; opportunity is fleeting; experiment is dangerous and decision is difficult.—First Aphorism of Hippocrates.

The question of the therapy of typhoid fever has been given considerable attention by scientists for the last three years. It now forms a new field of scientific research, among both clinicians and laboratory workers. Medical literature teems with reports of the favorable results obtained by different observers of the merits of the various methods employed; namely, the use of (*a*) foreign proteins and (*b*) colloidal preparations. These methods of treatment may be said to be still in the experimental stage. After three years of careful trial and observation, the views expressed by leading investigators with particular refer-

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ence to the action of vaccines are many, and opinion is far from unanimous. The claims made by some, that the curative effect of vaccines is due to their specific action, have been held to be untenable, so that many look upon the question as still unsettled.

It is my intention to make the present paper the basis of my contribution to this much-disputed question, although conscious of the fact that it requires some temerity to enter a field already occupied by so many distinguished American and European writers. I hope, however, to set forth some facts in connection with these methods of treatment and then to present the conclusions reached through my observations.

PRESENTATION OF THE CLINICAL CASES

Period of observation.—The present investigation covers a period of seven months, beginning August, 1917, and extending to February, 1918. During that time there were admitted to the medical department in the Philippine General Hospital ninety-eight cases of typhoid fever, all Filipinos. Both sexes are represented in the series. The minimum age was 14 years. Another series of twenty cases of typhoid fever has not been included with these ninety-eight cases for the reason that some were in a dying condition on admission and, therefore, short-lived in the hospital; and others were admitted in a convalescent state, in which they showed marked defervescence. In connection with these convalescent cases it was felt that the effects of the treatment under consideration in this paper might lead to erroneously favorable interpretations.

Source of material.—The source of the cases studied was the district of Manila. Relatively few cases came from Rizal, Cavite, Bulacan, and Laguna Provinces.

Type of epidemic.—Many of the patients on admission showed marked toxæmia, frequently associated with pneumonic, cardiac, or renal complications; while other cases were admitted in a condition of collapse, either with intestinal perforation or acute intestinal hæmorrhage. It can be fairly stated, then, that we were dealing with a severe type of epidemic. It should be further stated that, with very few exceptions, these typhoid cases belonged to the laboring class of the community, whose hygiene and dietary were very deficient. Upon falling ill many of them remained in their homes for a number of days without any medical attendance, and only applied to the hospital for admission when their condition had become very serious.

In these ninety-eight cases males predominated over females. The sex incidence is shown in Table I.

TABLE I.—*Sex incidence in typhoid fever.*

Sex.	Cases.	Deaths.	
			Per cent.
Male	65	14	21.5
Female	33	5	15.1
Total	98	19	19.38

Morbidity and mortality.—Out of these ninety-eight cases there were nineteen deaths, a mortality of 19.38 per cent, a very discouraging if not alarming figure. It should be remembered, however, that many of the cases showed little prospect of recovery, on account of their serious condition when admitted to the hospital. In fact, ten of the nineteen cases that died were considered hopeless on admission. Excluding these ten hopeless cases, therefore, reduces the mortality rate to 10.22 per cent. McCrae(31) gives 25 per cent as the mortality rate for British troops in South Africa; Curschmann,(5) 9 to 12 per cent; Osler,(37) 7 to 20 per cent in hospital practice, and 5 to 12 per cent in private practice; Rogers,(42) 16.3 per cent for white troops in the tropics and 26 per cent for Indians. In the Philippines Chamberlain(3) places the mortality rate at 17.65 per cent for Filipinos and 16.8 per cent for white troops in the tropics. Gutierrez,(12) of the Philippine General Hospital, in analyzing one hundred twenty-five cases of typhoid fever in 1913, gives 20.43 per cent; after excluding ten hopeless cases he gives a mortality rate of 13.13 per cent.

Selection of material.—Selection of cases is fraught with no less difficulty. The varying degree of severity of infection in each case, and the fact that some individuals came early for treatment while others came later, rendered comparison a difficult task. However, particular emphasis was laid on the severity of the individual case on admission. The cases were then grouped. It should be stated that the diagnoses in all these ninety-eight cases were established on clinical findings, and laboratory examination was then resorted to for confirmatory purposes. In each instance search was made for malarial parasites.

Clinical grouping of cases.—These ninety-eight cases were divided into groups according to the apparent condition of the individual case on admission or after one or two days' observation in the ward. Thus, cases that presented high fever and delirium, with or without complications, were classified as severe and toxic; those that presented high fever, with or without complications, but not apparently poisoned, were classified as

severe and nontoxic; while those with moderately high fever, without complications, and not apparently poisoned, were classified as mild. These classifications are, of course, more or less arbitrary and conventional. Classifications were made under these headings as follows:

TABLE II.—*Classification of cases of typhoid fever.*

	Cases.
Severe and toxic	26
Severe and nontoxic	47
Mild	25
Total	98

VARIETY OF TREATMENT

FOREIGN PROTEIN

Bacteria, being composed of protoplasmic matter, are considered to be protein substance. In fact, Robertson,(40) and Jobling, Petersen, and Eggstein,(17) have called this substance "bacterial protein." My view is that any organism, living or otherwise, becomes foreign protein when introduced into the host.

Typhoid fever, so far as I am aware, is the only disease in the treatment of which protein has been extensively employed. It has been used either in homologous or heterogonous forms. In the great majority of instances, however, vaccines in the form of foreign protein have been used. These consisted of either living sensitized organisms, dead sensitized organisms, or nonliving nonsensitized organisms. Sensitized organisms are bacilli that have been treated with immune serum, while nonsensitized nonliving organisms are killed bacilli that have not been treated with immune serum.

SENSITIZED, OR TREATED, VACCINE ADMINISTERED INTRAVENOUSLY

Vaccine treatment dates from 1893. Eugene Fraenkel(7) was the pioneer in this field. He employed a vaccine of killed typhoid bacilli, subcutaneously administered, for therapeutic purposes in typhoid fever, and he claimed to have modified the course of the disease. His work received scant attention from early investigators. Nine years passed before reports of similar observations came from Petruschy(38) in 1902. Then followed the work of Pescarole and Quadrone(39) in 1908. Ichikawa,(15) in 1914, used the intravenous method of administration of living sensitized typhoid vaccine and secured excellent results. His success awakened interest in this form of treatment; and since then, according to Gay and Chickering,(11) it has received careful trial at the hands of such leading investigators as Koranyi,

Biedl, Eggerth, Sladek and Kotlowski, Boral, Holler, Lowy, Luksch, and Wilhelm and Myer.

Variety of sensitized typhoid vaccine.—So far as I am aware, there are four kinds of this type of vaccine; namely, (*a*) Ichikawa's living attenuated sensitized vaccine, (*b*) Besredka's(1) living sensitized vaccine, (*c*) Gay's(9) sediment vaccine, and (*d*) sensitized killed vaccine.

Dosage.—The dose administered intravenously varies according to the kind of vaccine. Thus, of Besredka's vaccine there have been used from 100 to 300 millions; Ichikawa's vaccine, from 200 to 300 millions; Gay's vaccine, from 0.2 to 0.4 milligram (150 to 300 millions). The dosage of killed sensitized vaccine is from 50 to 800 millions as indicated by Jobling;(17) 70 to 300 millions, by Dithorn and Schultz;(6) and equal parts of typhoid and paratyphoid bacilli (500 millions) is the amount employed by Robertson.(40) I have employed a dosage of from 250 to 1,000 millions of killed sensitized typhoid bacteria intravenously, increasing the doses every three or four days according to the case.

Contraindications.—According to eminent writers on the subject, weakness of the heart, presence of pneumonia, and intestinal hæmorrhage are contraindications for vaccine treatment. Thus Sladek and Kotlowski(46) believe that it increases peristalsis of the intestines, with subsequent danger of hæmorrhage and perforation. My experience leads me to believe that vaccine therapy is as yet of very limited applicability, and I do not feel that I am in a position to confirm or controvert their observations. However, I have employed this treatment in all conditions, except in cases of intestinal hæmorrhage, and so far there have been no untoward effects that could be attributed directly to the treatment.

This series comprises fifty-one cases of typhoid admitted during the height of the epidemic, of which thirty cases were subjected to intravenous injection of polyvalent sensitized typhoid vaccine, while twenty-one cases were used as controls.

The clinical grouping of cases given vaccine treatment intravenously is shown in Table III.

TABLE III.—*Condition of patients before treatment.*

	Cases.
Severe and toxic	9
Severe and nontoxic	15
Mild	6
Total	30

Method of treatment.—The view that sensitized typhoid vaccine is considered less toxic than nonsensitized typhoid vaccine seems to be the consensus among investigators at present. Cecil,(2) Garbat,(8) and Nichols(35) have shown by experiments with animals that such is the case. Cecil, however, has found that the lethal dose of sensitized typhoid vaccine is three times as large as that of the nonsensitized bacilli. Reasoning from this point of view, since McWilliams(34) has used intravenously 500 millions of plain nonsensitized killed typhoid bacilli as the initial dose, the safe limit of dosage for sensitized organisms would be 1,500 millions; I have used, therefore, 250 to 500 millions as my dose and, in a very few cases, 1,000 millions. I have never exceeded 1,000 millions, even in repeated doses.

The vein selected for intravenous injection is the median basilic, this vessel being commonly prominent, although the injection may be given in any other vein provided the site is rendered aseptic. The injection should be done under rigid asepsis and preferably by the closed method.

The results of the treatment of thirty cases by intravenous injection of sensitized vaccine are shown in Table IV.

TABLE IV.—*Sensitized typhoid vaccine administered intravenously.*

Classification by results.	Cases.			Total.	Days before treatment.	Duration of treatment.	Duration of disease.
	Mild.	Severe.	Severe and toxic.				
						Days.	*Days.*
Aborted	4	3	0	7	8.2	5.1	13.3
Benefited	2	12	0	14	11.5	14.4	25.9
Relatively unaffected	0	0	3	3	8	25.3	33.3
Deaths	0	0	6	6			
Crisis				4			
Lysis				10			
Average							24.1

In Table IV the cases have been separated into groups according to the results; namely, (*a*) aborted type, (*b*) benefited type, and (*c*) relatively unaffected type.

There were seven aborted cases out of thirty cases treated intravenously, with an average duration of treatment of 5.1 days, in contrast to seven days observed by Gay.(9) McCrae(32) in analyzing fifteen hundred cases found 0.1 per cent that recovered by crisis. In my series, I found 23.33 per cent of aborted cases. It is interesting to note that the aborted cases were observed during the first week, and that they have a direct

relation to intravenous injections. This abortive type was observed in mild cases in the majority of instances and in severe cases in a few instances. The temperature record of one of the abortive cases is shown in the accompanying chart (fig. 1).

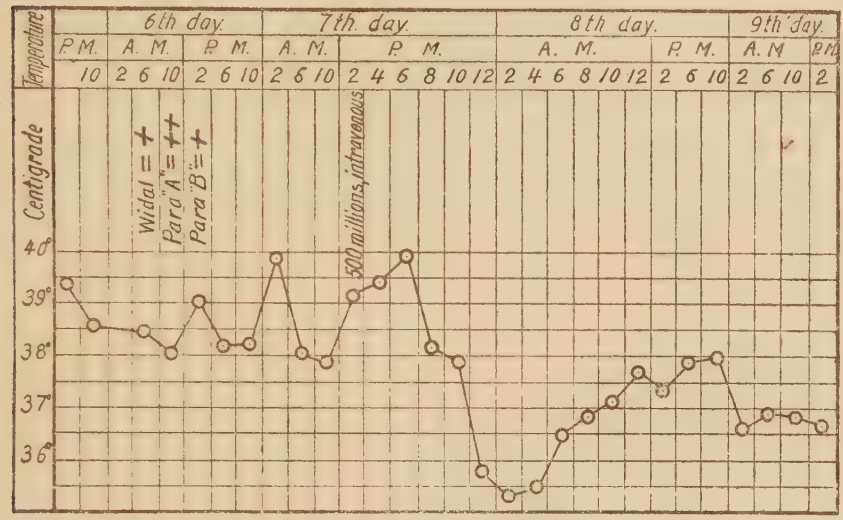

FIG. 1. Temperature chart of B. Y. Abortive type of typhoid fever, treated with sensitized typhoid vaccine intravenously.

The benefited type was observed during the second week. As a rule the temperature drops, either by crisis or by lysis, following each successive intravenous injection; but afterward it rises again temporarily, then becoming permanently normal. The average duration of treatment was 14.4 days in my cases, while in those of Gay it was 15.8 days. Examples of the benefited cases are shown in the accompanying charts (figs. 2, 3, and 4).

The relatively unaffected type was observed in advanced cases. Each injection was followed by a temporary drop in temperature, which subsequently in some cases resumed the original level at which it was before the injection, while in others it became slightly remittent or intermittent. The course of the disease was slightly altered. The average duration of the disease was 25.3 days in this series.

Symptomatology.—From thirty minutes to one hour after the intravenous injection of vaccine, the patient as a rule feels a slight chilly sensation as a prodromal symptom. This lasts for a few minutes; then follows the real shaking of the entire body. This rigor shows varying degrees of intensity according to individual susceptibility, and may last for from fifteen to thirty-

five minutes. During this period the pulse and the respiration are slightly increased in rate, and the skin is pale and feels cold; the temperature is usually high, reaching its maximum height in from three to six hours. It then falls, generally either by crisis or by lysis, or else it may become intermittent or remittent. There are cases, however, in which the temperature drops by crisis or lysis without chills or a preceding rise in temperature. Such cases are relatively rare. The crisis may

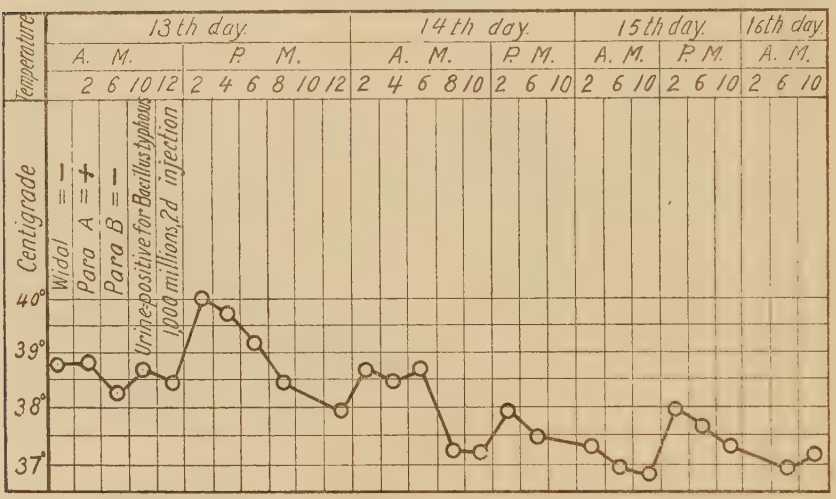

FIG. 2. Temperature chart of E. N. Benefited type of typhoid fever, treated with sensitized typhoid vaccine intravenously.

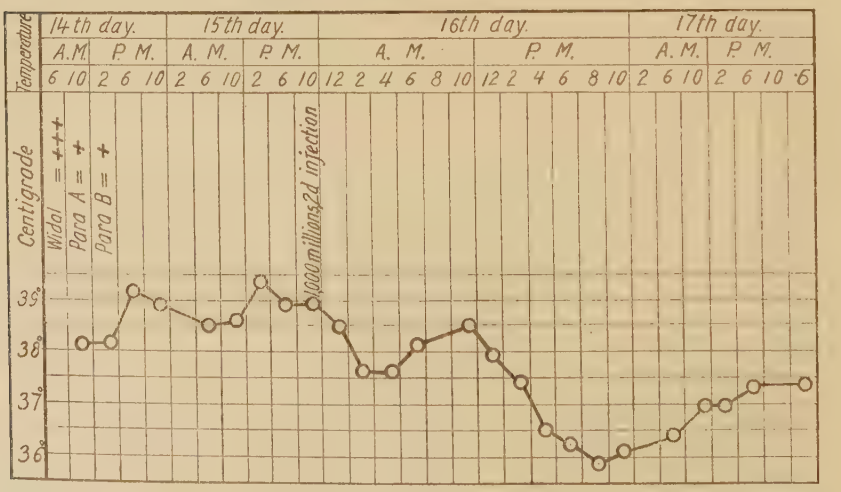

FIG. 3. Temperature chart of M. L. Benefited type of typhoid fever, treated with sensitized typhoid vaccine intravenously.

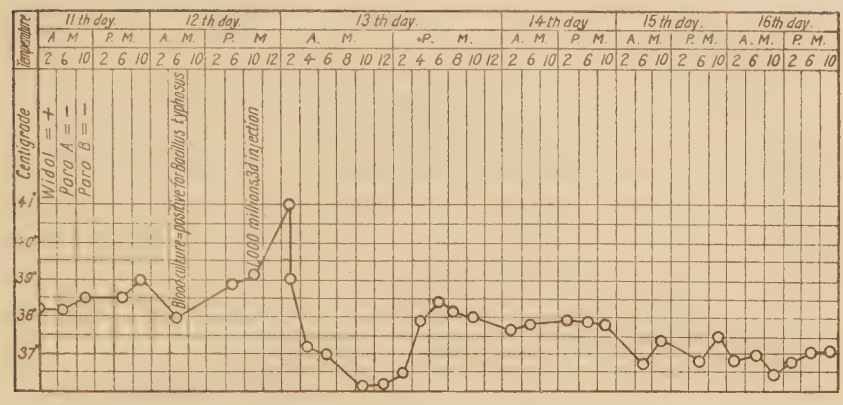

FIG. 4. Temperature chart of N. C. Benefited type of typhoid fever treated with sensitized typhoid vaccine intravenously.

reach a normal or a subnormal level about twelve hours after injection. The rigor is followed by thirst, cold perspiration, and relaxation, but accompanied by a feeling of marked alleviation of subjective symptoms. In the majority of instances the patient, previously sleepless, is able to sleep soundly the following night.

The temperature may remain permanently at the normal level, and in this event no further injection is necessary; but, if the temperature should rise again for a period of three or four days, another injection is needed with increasing dose. My experience is that two or three doses are sufficient to produce the desired result; if without result, further injections seem to be of no value.

According to Gay and Chickering,(11) and McWilliams,(34) there is a leucopenia during the rise of temperature, and hyperleucocytosis during the apyretic period. They were able to observe these phenomena by frequently examining the blood of the patients. I was unable to make frequent examinations of the blood of the patients injected, but examination of the blood twenty-four hours after injection revealed a slight increase in the leucocyte count.

I have observed that a moderate reaction is very necessary to produce beneficial results. Similar observations have been confirmed by Gay(9) and claimed by Leake.(24) To avoid errors in interpretation of results, it is highly advisable to base one's judgment on the effects of treatment; that is to say, not from the subjective symptoms, but rather from the objective phenomena, such as shortening of the duration of the fever or,

in other words, the occurrence of the abortive type in relation to injection.

Complications.—Excluding eight cases, in which complications were already present on admission into the hospital, six developed complications during treatment. In ninety-eight cases treated by Gay,(9) he observed thirteen that developed complications; namely, pyelitis, one case; lobar pneumonia, one; laryngitis, two; bronchopneumonia, two; toxæmia, one; hæmorrhage, four; and perforation, two.

Table V shows the complications that were observed during treatment and before treatment was begun.

TABLE V.—*Complications before and during treatment.*

Complication. [a]	Developed before treatment.	Developed during treatment.
Pneumonia	8	3
Intestinal hæmorrhage	0	[b] 2
Bronchopneumonia	1	1
Total cases	9	6

[a] Relapses, three cases.

[b] One case had hæmorrhage four days after injection; another case, during convalescence.

Early investigators, Krumbhaar and Richardson,(22) Waitzfelder,(48) and Robertson,(40) held the belief that vaccine therapy diminishes the complications. But Table V seems to show that it has no advantageous effect on the complications as compared with my controls. Whittington,(49) who has had considerable experience with vaccine therapy, reports that he observed a higher percentage of complications (49.5 per cent) under vaccine treatment, while his controls showed 46 per cent. His observation is based upon one hundred fifteen cases treated with vaccine and another one hundred fifteen under classical treatment.

Relapses.—In my thirty cases, treated with vaccine, three had relapses, lasting only a few days. Gay advised subcutaneous injection of vaccine a few days after the intravenous, so as to prevent relapse. Again, Whittington found a higher percentage of relapses in cases treated with vaccine (10.4 per cent), in contrast to 7.8 per cent observed in his controls. In my controls I had five relapses (23.9 per cent), a higher number than shown by the cases that had undergone vaccine treatment (10 per cent). This difference in results may be due to the limited series that I have had so far.

Concomitant disease.—On examining these thirty cases, two cases of tuberculosis were found. One was a case of incipient pulmonary tuberculosis that later became active during the course of the disease. It seemed that vaccine treatment administered intravenously had done harm to the patient; because, after the injection and consequent shaking up of the body, it was noticed that traces of blood were found in his sputum. This might be a mere coincidence, but it should be regarded with suspicion. It seems advisable to exercise prudence and caution in the use of vaccine for patients suffering from pulmonary tuberculosis. The other case was a tuberculous cervical adenitis. In this particular case vaccine injection was not followed by any untoward effects.

Mortality.—The mortality in these thirty cases is 20 per cent, a very high rate. It should be remembered, as already stated, that these patients belonged to the laboring class who did not realize the advantage of early hospitalization. Consequently they had remained in their respective homes without adequate treatment and care, only coming to the hospital at a time when medical attention would be of little avail because of the advanced stage and seriousness of the cases. In fact, there were three cases in which I considered the outlook on admission as hopeless on the grounds of marked toxæmia and pulmonary complications. By excluding these three hopeless cases, the mortality is reduced to 10 per cent. Autopsy findings will reveal the causes of death, as shown in the following protocols:

Autopsy findings (sensitized intravenous treatment).

File No. 1957: D. H.

Anatomic diagnosis: Bilateral lobar pneumonia with abscess and gangrene of the lung; typhoid enteritis; acute parenchymatous degeneration of the viscera; chronic fibrous pleurisy.

File No. 1830: V. C.

Autopsy findings: Typhoid ulcerated enteritis, healing; acute hæmorrhagic bronchopneumonia; acute pyonephritis; parenchymatous degeneration of the liver; fatty degeneration of the heart; acute myocarditis.

File No. 1875: S. C.

Anatomic diagnosis: Intestinal hæmorrhage; acute ulcerative enterocolitis, typhoid; acute splenitis, mesenteric; parenchymatous degeneration of the heart and liver; acute parenchymatous nephritis with some interstitial nephritis; focal necrosis of the liver; emaciation; ascariasis; trichuriasis.

File No. 1985: F. J.

Anatomic diagnosis: Beginning lobar pneumonia, right; typhoid enteritis; acute parenchymatous nephritis; acute parenchymatous degeneration of the heart and liver; calcareous nodule in the left lung; ascariasis.

The above necropsy records show that no known treatment would have prevented the fatal outcome. Undoubtedly, these patients died of what are commonly known as "accidents of typhoid."

Gay and Chickering,(11) in 1915, had 9 per cent mortality in fifty-three cases, treated with their vaccine; Gay,(9) in 1917, had 6.6 per cent mortality in ninety-eight cases. In my series the mortality is 10 per cent, after excluding the three hopeless cases. Ichikawa,(15) however, in 1914, had 12 per cent mortality in eighty-two cases; but his controls showed 30 per cent mortality, while my controls showed 23.8 mortality. McWilliams(34) has this to say about the rate of mortality:

> The percentage mortality in itself offers but little evidence as to the danger or efficacy of the treatment, as it will necessarily vary according to whether only mild cases, only severe cases, or all types of cases are subjected to the injections. The highest death rate, 23 per cent., was observed by Paulicek. His patients were soldiers who had suffered from severe exposure in cold weather, and they died in most instances from a complicating pneumonia. The high mortality of 23 per cent. represents, he says, a reduction by 20 per cent. from what was obtained without the injection of vaccine. It has already been mentioned that the death rate in Ichikawa's control cases was more than twice as high as in the treated cases.
>
> Of far greater importance than the percentage mortality is the question as to how many, if any, of the deaths could be attributed directly to the action of the vaccine. Five cases (treated by Boral, by Csernel and Marton, by Löwy, Luksch and Wilhelm, and by Paulicek) showed intestinal hemorrhage following the injection and terminated fatally. One case (of Sladik and Kotlowski) resulted fatally from hemorrhage into the thyroid gland. One of Eggerth's patients developed a hemorrhage from the lungs and died three hours after the injection. One of Biedl's had hemorrhage from the nostrils before the intravenous injection of vaccine was given; after the treatment the hemorrhage recurred and could not be stopped.

CONTROLS

The fact is well known to all who have had experience with the disease that, strictly speaking, no two cases of typhoid fever are of equal severity. But this does not mean that we should disregard entirely the value of controls; for, although the results are not necessarily equal, yet, taking them as a whole, the factors concerned are minimized and the results thus obtained are approximate, if not exact.

By the term control, as used in this paper, I mean the classification of typhoid patients into groups of cases showing a more or less equal degree of infection, as a basis of comparison with other groups of patients, similarly affected by the same disease but undergoing different kinds of therapy. That is to say, the

controls are grouped conjointly with the cases that are subjected to the intravenous treatment with sensitized vaccine.

These control cases were subjected to classical treatment, which consists in the application of general hygiene and care; the administration of light, nourishing food; the application of hydrotherapy, either cold or tepid; and absolute rest. As an accompaniment to this treatment the patient may be given cardiac stimulation, soda enemata (1.5 per cent solution) every other day, and occasional, small doses of urinary antiseptics. The patient may be given 1,000 cubic centimeters of proctoclysis daily of normal saline solution and should be encouraged to drink plenty of water as an aid to disintoxication.

This series consists of twenty-one cases. Their clinical grouping is shown in Table VI.

TABLE VI.—*Condition of patients before treatment.*

	Cases.
Severe and toxic	6
Severe and nontoxic	11
Mild	4
Total	21

In the sixteen cases remaining after five deaths are excluded the average duration of the disease was 27.7 days, while in the cases treated with sensitized vaccine, as previously stated, it was 24.1 days. Gay,(10) in using similar treatment, found that the average duration of the disease was 27.6 days. McCrae,(33) in analyzing fifteen hundred cases of typhoid, found that the average duration was thirty-one days.

Complications.—Out of these twenty-one cases there were eight cases that developed complications, two of which showed them on admission. Table VII shows the variety of the complications:

TABLE VII.—*Complications in eight cases of typhoid fever.*

	Cases.
Lobar pneumonia (present on admission)	2
Bronchopneumonia	3
Perforation	1
Intestinal hæmorrhage	2
Total	8

In connection with these complications, it is interesting to compare the complications that developed only during vaccine treatment with those that appeared in the controls as shown in Table VIII.

TABLE VIII.—*Complications in control cases.*

	Cases.
Controls (after excluding 2 cases in which complications were present on admission)	6
Sensitized vaccine treatment	6

The above comparison differs somewhat from the results obtained by other investigators, such as Gay(9) and Waitzfelder,(48) who have claimed that vaccine therapy diminishes the incidence of complications. My results, however, are somewhat similar to those of Whittington,(49) who found that well-controlled cases develop a smaller number of cases of complications. The discrepancy between my observations and those of Whittington may be due to the fact that he observed a greater number of controls than I had available for treatment.

Mortality.—The rate of mortality is very discouraging, if not alarming. There were five deaths out of twenty-one cases, a mortality of 23.8 per cent. If we exclude the two cases that I considered hopeless on admission, the rate of mortality will be reduced to 14.3 per cent. Only two cases were autopsied out of five deaths, and the anatomic diagnoses show the following:

Anatomic diagnoses (autopsy findings of control cases).

File No. 1749: I. S.

Anatomic diagnosis: Acute ulcerative enteritis (typhoid); suppurative peritonitis following perforation; acute parenchymatous degeneration of the viscera; cardiac dilatation; œdema of the meninges.

File No. 1834: B. C.

Anatomic diagnosis: Acute enteritis (typhoid), congestion, and beginning necrosis; acute splenitis; acute lymphadenitis, mesenteric; acute dilatation of the heart; acute parenchymatous nephritis; parenchymatous degeneration of the heart and liver; focal necrosis of the liver; chronic caseous lymphadenitis, bronchial; chronic fibrous pulmonary tuberculosis; emphysema, interstitial; ascariasis.

Again, I have to state that the untreated control cases of Ichikawa(15) showed a mortality rate of 30 per cent in comparison with my mortality of 14.3 per cent after two hopeless cases were excluded.

SENSITIZED VACCINE ADMINISTERED INTRAMUSCULARLY

Early in 1911 Metchnikoff and Besredka(27) advocated the use of living sensitized typhoid vaccine intramuscularly for prophylactic purposes and claimed to have secured excellent results thereby. Followers of this school have adopted that practice and have even gone so far as to use this form of vaccine as a

therapeutic agent, and they have drawn others into the ranks. Among the leading investigators in this field, according to Gay and Chickering,(11) are Ardin-Delteil, Negre and Raynoud, Boinet, Delearde and Leborgne, Sable, Netter, Roques and Alfaro, Feistmantel, and Garbat.

In this series there were ten cases treated with sensitized typhoid vaccine intramuscularly, and the series was treated just after the series of cases treated intravenously with sensitized vaccine.

TABLE IX.—*Condition of patients before treatment.*

	Cases.
Severe and toxic	3
Severe and nontoxic	3
Mild	4
Total	10

Mode of treatment.—The sensitized typhoid vaccine, as stated previously, was administered intramuscularly. The dosage employed was from 250 to 1,000 millions every three or four days. Gay advised 800 millions every other day and Garbat 500 millions every five or six days. The results of this treatment upon the course of the disease are shown in Table X.

TABLE X.—*Sensitized typhoid vaccine administered intramuscularly.*

Classification by results.	Cases.			Total.	Days before treatment.	Duration of treatment.	Duration of disease.
	Mild.	Severe and nontoxic.	Severe and toxic.				
						Days.	*Days.*
Aborted	4	0	0	4	10	3.2	13.2
Benefited	0	2	0	2	16	11.0	27.0
Relatively unaffected	0	1	0	1	11	32.0	43.0
Deaths			3	3			
Crisis				1			
Lysis				3			
Average							27.7

Thus, it may be seen that there were four abortive cases, all observed in the beginning of the second week, and all of them mild, in which the average duration of the disease was 13.2 days; two benefited cases, during the third week, both of the severe and nontoxic type, with twenty-seven days as the average duration of the disease; and one relatively unaffected case of the same type as the benefited cases, with forty-three days as the average duration of the disease. The total average duration of

the disease was 27.7 days. Fall of temperature by crisis was observed in only one case and fall by lysis in three cases, all in cases of the aborted type.

Symptomatology.—The intramuscular injections were not followed by the train of symptoms observed in the case of the intravenous injections. However, there was a slight rise of temperature, appearing in the majority of cases from twelve to twenty-four hours following injection, and rarely after this time. The temperature in such instances may fall by lysis and, very seldom, by crisis. During the course of the treatment it was observed that a mild reaction was necessary in each case to obtain the desired result.

Complications.—The complications are summarized in Table XI.

TABLE XI.—*Complications before and during treatment.*

	Before treatment.	During treatment.
Lobar pneumonia	1	1
Bronchopneumonia	0	1
Hæmorrhage	0	0
Total	1	2

There were two cases that developed complications during the treatment, giving a rate of 20 per cent; one case was lobar pneumonia and the other bronchopneumonia.

Mortality.—The total mortality in these ten cases was three, a death rate of 30 per cent, which is exceedingly high. Excluding two cases admitted in a very serious condition, the mortality rate would be 10 per cent. The deaths that occurred did not follow immediately after injection, but two days later. Only two cases were autopsied; the findings are shown below:

Autopsy findings (sensitized intramuscular treatment).

File No. 1968: J. P.

Anatomic diagnosis: Typhoid enteritis (healing); acute parenchymatous degeneration, viscera; beginning lobar pneumonia, right; chronic fibrous pleurisy; œdema of the meninges.

File No. 1914: V. H.

Anatomic diagnosis: Bilateral bronchopneumonia; typhoid enteritis (healing); cardiac dilatation; acute parenchymatous degeneration, viscera; acute cholecystitis.

It will be seen, therefore, that the patients died of "typhoid accidents."

Garbat(8) in his paper quotes the results obtained by some investigators who employed sensitized typhoid vaccine intramuscularly, thus: Boinet (1913), 15 cases; Szecsy, 112 cases; and Garbat (1911–1912), 17 cases. All of these authors observed good results.

NONSENSITIZED, UNTREATED VACCINE, ADMINISTERED INTRAVENOUSLY

Following the report by Ichikawa(15) in 1914, on intravenous injection of sensitized typhoid vaccine in the treatment of typhoid fever, many investigators used his method, but they employed a vaccine of the plain bacilli killed by heat. Among Ichikawa's leading followers according to Gay and Chickering(11) are Thiroloix and Bardon, Kraus and Mazza, Kraus, Biedl, Csernel and Marton, Rhein, Reibmayr, Mazza, Holler, Lowy, Luksch and Wilhelm, Paulicek, Dithorn and Schultz, and McWilliams. All of these investigators observed beneficial results following the use of this form of vaccine.

There were nine cases in this series treated with nonsensitized vaccine, administered intravenously. However, the patients in this series had been treated at a different time, following the treatment of the series that had undergone treatment by intramuscular injection of sensitized vaccine. The clinical grouping of these cases is shown in Table XII.

TABLE XII.—*Condition of patients before treatment.*

	Cases.
Severe and toxic	1
Severe and nontoxic	6
Mild	2
Total	9

The results of this treatment are illustrated in Table XIII.

TABLE XIII.—*Nonsensitized vaccine administered intravenously.*

Classification by results.	Cases.			Total.	Days before treatment.	Duration of treatment.	Duration of disease.
	Mild.	Severe and nontoxic.	Severe and toxic.				
						Days.	*Days.*
Aborted	2	3	0	5	11.8	3.9	15.1
Benefited	0	3	0	3	15.3	9.6	24.9
Relatively unaffected				0			
Deaths			1	1			
Crisis				1			
Lysis				3			
Average							20.0

As shown in Table XIII there were five aborted cases, observed during the second week of the disease, of which two were mild and three were severe and nontoxic, with an average duration of the disease of 15.1 days. On the other hand there were three benefited cases, all of which were severe and nontoxic, with an average duration of 24.9 days. The total average duration for the aborted and benefited cases was twenty days, in contrast to 24.1 days, the total average duration for the cases treated with sensitized vaccine intravenously. The difference in results may be accounted for by the difference in the severity of the cases, the period of observation, and the relatively fewer cases in the series. An illustration of the abortive type is shown in the accompanying charts (figs. 5 and 6).

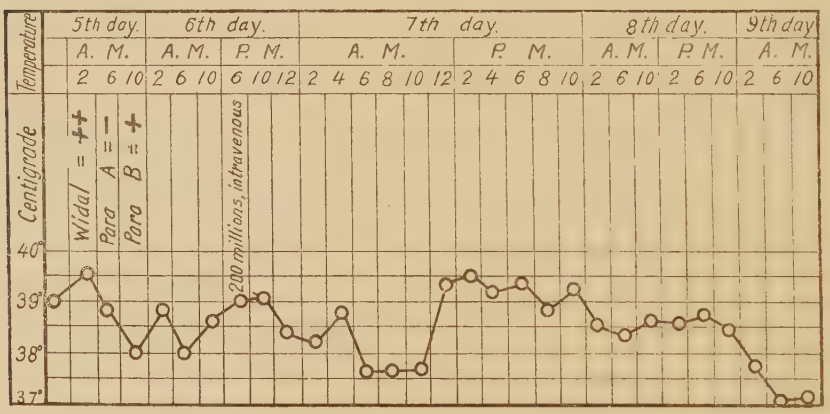

FIG. 5. Temperature chart of J. A. Abortive type of typhoid fever, treated with nonsensitized typhoid vaccine intravenously.

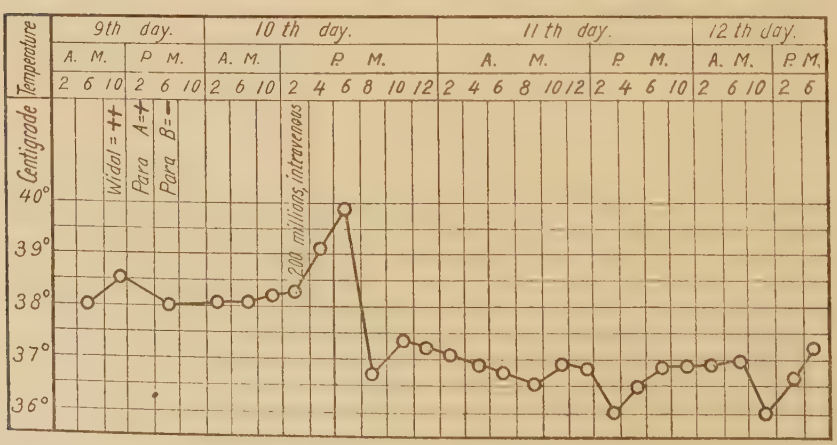

FIG. 6. Temperature chart of C. G. Abortive type of typhoid fever, treated with nonsensitized typhoid vaccine intravenously.

Symptomatology.—The symptoms observed were similar to those that had been met with in the patients treated with sensitized vaccine.

Dosage.—Dithorn and Schultz used 70 to 300 million bacteria as their dosage, Miller and Lusk(29) used 200 millions, and McWilliams(34) used 250 to 500 millions. The doses used in this investigation range from 200 to 250 millions. Gay and Chickering(11) state that, if an overdose is administered, alarming or dangerous symptoms may supervene.

Complications.—There were three cases that had lobar pneumonia as a complication before treatment was begun, and one developed intestinal hæmorrhage three days after injection. Table XIV shows the number of cases and the kind of complication that developed.

TABLE XIV.—*Complications before and during treatment.*

	Before treatment.	During treatment.
Lobar pneumonia	3	0
Intestinal hæmorrhage	0	[a] 1
Total	3	1

[a] Appeared three days after injection and recovered.

It will be seen in Table XIV that there was but one case in which the treatment might be suspected as having been the cause of intestinal hæmorrhage, but there was not sufficient clinical evidence to support the suspicion. In this case the hæmorrhage did not appear until three days after the injection, while McWilliams(34) recorded in her paper five cases reported by Boral, by Csernel and Marton, by Löwy, by Luksch and Wilhelm, and by Paulicek, in which it was evident that intestinal hæmorrhage, terminating fatally, followed the injection. One of Eggerth's patients developed a hæmorrhage from the lungs and died three hours after the injection.

Mortality.—The mortality in nine cases is one, giving a mortality rate of 11.1 per cent. This case was deemed hopeless on admission, and autopsy findings indicate that the patient died of the so-called "typhoid accidents."

Autopsy findings (nonsensitized intravenous treatment).

File No. 2302: P. N.

Anatomic diagnosis: Ulcerative enterocolitis, typhoid; acute splenitis; acute lymphadenitis, typhoid; marked focal necrosis, liver; miliary tuberculosis, pleura; acute parenchymatous nephritis; parenchymatous degeneration of the heart.

PEPTONE

Nolf(36) in February, 1917, published his extended observations made in France during the war, on parenteral injection of peptone solution in the treatment of infectious diseases in general. His experience has shown the efficacy of this treatment in typhoid fever, in the consequent "warding off of intestinal hæmorrhage from reduced coagulating power of the blood." He employed 10 cubic centimeters of a 5 per cent solution intramuscularly in the gluteal region. Intravenous injection should be given slowly and with caution. I was able to apply this form of treatment intramuscularly in a very limited number of cases that were admitted at the end of the epidemic, when morbidity was reduced to the minimum. This series consists of five cases, and the relative severity of the infection in each patient is illustrated in Table XV.

TABLE XV.—*Condition of patients on admission.*

	Cases.
Severe and toxic	0
Severe and nontoxic	2
Mild	3
Total	5

Following the injection of 10 cubic centimeters of a 5 per cent sterile peptone solution every two or three days two mild cases aborted in the beginning of the second week of the disease, with 12.5 days as the average duration of the disease. Three cases were benefited; of these, one was mild and two were of the severe and nontoxic type, with twenty-two days as the average duration of the disease. The total average duration of the disease in this group is 17.2 days. There were but two cases of defervescence by lysis, and none showed a temperature fall by crisis. A summary of the results of the treatment is shown in Table XVI.

TABLE XVI.—*Peptone injection.*

Classification by results.	Cases.			Total.	Days before treatment.	Duration of treatment.	Duration of disease.
	Mild.	Severe and nontoxic.	Severe and toxic.				
						Days.	*Days.*
Aborted	2	0	0	2	8.5	4	12.5
Benefited	1	2	0	3	12.0	10	22.0
Relatively unaffected	0	0	0	0			
Deaths				0			
Crisis				0			
Lysis				2			17.2

Symptomatology.—The symptoms observed were: Slight rise in temperature, supervening from twelve to twenty-four hours after treatment and rarely after forty-eight hours; slight leucocytosis after twenty-four hours; and slight alterations of subjective symptoms. The temperature may assume the lytic, remittent, or intermittent type. An example of the lytic type of temperature curve is shown in fig. 7.

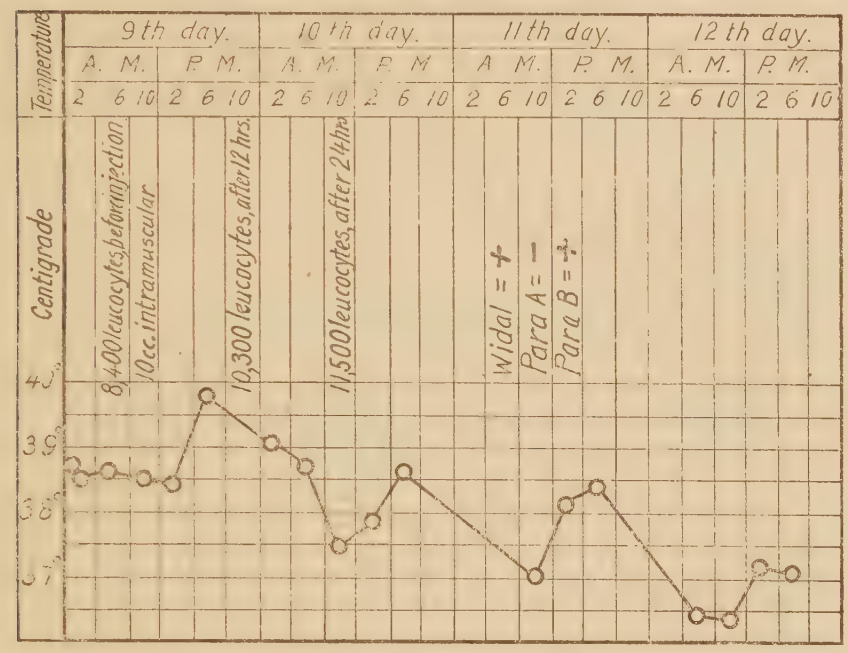

FIG. 7. Temperature chart of F. V. Abortive type of typhoid fever, treated with peptone intramuscularly.

Complications.—Complications observed during the treatment were one case of acute bronchitis and one case of intestinal hæmorrhage (hæmorrhage present at admission).

Mortality.—As these cases were all admitted when the epidemic was in its terminal period and morbidity not at its maximum, none resulted fatally.

MILK

Saxl(45) in 1916 successfully employed sterile milk in typhoid fever, administered intramuscularly. In fact, it is commonly used in Germany. The principle involved in this treatment is the introduction of a heterogonous protein substance, which constitutes a considerable portion of the milk.

The dosage that I have employed was from 10 to 20 cubic centimeters intramuscularly injected in the gluteal region.

Eight cases were treated with milk, all of which were admitted into the hospital when the morbidity of the epidemic was declining.

The condition of the respective patients on admission is shown in Table XVII.

TABLE XVII.—*Condition of patients on admission.*

	Cases.
Severe and toxic	2
Severe and nontoxic	4
Mild	2
Total	8

The results of the treatment in this series are summarized in Table XVIII.

TABLE XVIII.—*Milk injection.*

Classification by results.	Cases.			Total.	Days before treatment.	Duration of treatment.	Duration of disease.
	Mild.	Severe and nontoxic.	Severe and toxic.				
						Days.	*Days.*
Aborted	2	0	0	2	8	4.5	12.5
Benefited	0	2	0	2	9	13.0	22.0
Relatively unaffected	0	2	0	2	11	17.5	28.5
Deaths	0	0	2	2			
Crisis				0			
Lysis				2			
Relapses				0			
Average							21.0

It will be seen that only two mild cases aborted during the second week of the disease, with an average duration of the disease of 12.5 days; two of the severe and nontoxic type were benefited during the second week of the disease, with twenty-two days as the average duration of the disease; and two cases of the severe and nontoxic type were unaffected, with 28.5 days as the average duration of the disease. The total average duration was twenty-one days. There were two cases of temperature fall by lysis, and two that showed an elevation of temperature. The latter two were observed in connection with the formation of an abscess in the gluteal region in each case, as

the result of imperfect sterilization of the milk used. Upon evacuation of the abscess the temperature completely subsided after twenty-four hours. Of all the injections made, only these two cases developed such abscess formations. The accompanying chart shows the effect of the treatment (fig. 8).

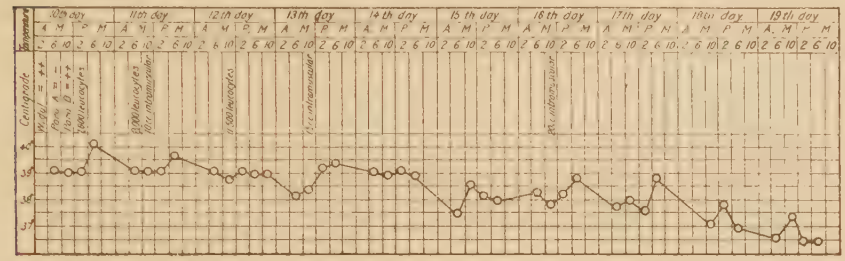

FIG. 8. Temperature chart of E. A. Illustrating the effect of intramuscular injection of milk.

Symptomatology.—The symptoms observed were: A slight rise of temperature; pain and tenderness in the gluteal region; slight leucocytosis; and gradual amelioration of subjective symptoms. The temperature may become lytic, remittent, or intermittent. An example of the benefited type in which the temperature became remittent, finally falling to normal, is illustrated in the accompanying temperature record.

Complications.—The complications that were observed are shown in Table XIX:

TABLE XIX.—*Complications before and during treatment.*

	Before treatment.	During treatment.
Lobar pneumonia	1	1
Intestinal hæmorrhage	1	[a]1
Abscess of the buttocks	0	2
Total	2	4

[a] Hæmorrhage appeared five days after injection and the patient died.

Table XIX shows that four cases exhibiting complications were observed during the treatment, of which one case was lobar pneumonia, one case was intestinal hæmorrhage, and two cases had abscess in the buttocks accounted for by improper sterilization of the milk used.

Mortality.—There were two deaths out of eight cases, giving a mortality rate of 25 per cent. One of these cases that died

was delirious and semiconscious, from the time of admission up to death. Autopsy findings of these two cases are as follows:

Autopsy findings (milk injection).

File No. 2662: S. L.

Anatomic diagnosis: Acute ulcerative enteritis with hæmorrhage (typhoid); acute splenitis and lymphadenitis (mesenteric); acute cardiac dilatation; acute parenchymatous degeneration of the viscera.

File No. 100: M. C.

Anatomic diagnosis: Ulcerative enteritis (healing typhoid); intestinal hæmorrhage; subacute splenitis; dilatation of the heart; bronchopneumonia (hypostatic); suppurative nephritis; acute myocarditis; parenchymatous degeneration of the liver; fibroma, left kidney.

The above necropsy records show that the patients died of complications.

COLLOIDAL GOLD INJECTED INTRAVENOUSLY

Colloidal gold, or colibiase as it is sometimes called, has been used extensively by French clinicians for a variety of infectious diseases, such as typhoid fever. Among the leading clinicians following this method, according to Gay,(9) are: Letulle and Mage(25) in 1914, Gay in 1915, Barachon in 1916, Labbe and Mausand in 1916, and Delbet in 1916.

A series of fifteen patients was treated intravenously with colloidal gold in connection with this study. This treatment was carried out when the morbidity of the epidemic was going down. The clinical grouping of the cases is given in Table XX.

TABLE XX.—*Condition of patients.*

	Cases.
Severe and toxic	5
Severe and nontoxic	7
Mild	3
Total	15

Dosage.—The dose employed by Letulle and Mage(25) in connection with their forty-two cases ranged from 1 to 2.5 cubic centimeters intravenously, 1 cubic centimeter for mild cases and 2.5 cubic centimeters for severe cases. The dose administered in my series was from 0.5 to 5 cubic centimeters intravenously, depending upon the severity of the case. In the majority of instances, 2 to 3 cubic centimeters was the initial dose.

The results of the treatment are shown in Table XXI.

TABLE XXI.—*Colloidal gold injected intravenously.*

Classification by results.	Cases.				Days before treatment.	Duration of treatment.	Duration of disease.
	Mild.	Severe and nontoxic.	Severe and toxic.	Total.			
						Days.	*Days.*
Aborted	3	2	0	5	6.6	4.2	10.8
Benefited	0	5	0	5	10.8	11.4	22.2
Relatively unaffected	0	0	3	3	13.0	20.3	33.3
Deaths	0	0	2	2			
Crisis				1			
Lysis				4			
Relapse				1			
Average							22.1

As shown above, the five aborted cases, three of which were mild and two severe and nontoxic, were all observed during the first week of the disease and had an average duration of disease of 10.8 days; the five benefited cases during the second week, all of which were severe and nontoxic, had an average duration of the disease of 22.2 days; the three relatively unaffected cases, all of which were severe and toxic, had an average duration of the disease of 33.3 days. The total average duration of the disease was 22.1 days. In one of the cases temperature fall by crisis was observed, in four cases decline by lysis was noted, and in only one case did a relapse develop. The charts, figs. 9 and 10, show the effect of the treatment.

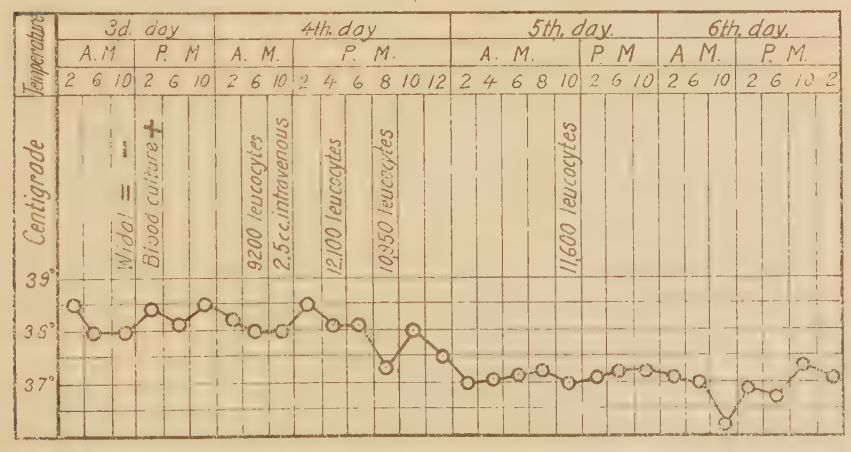

FIG. 9. Temperature chart of J. R. Abortive type of typhoid fever, treated with colloidal gold intravenously. Widal negative till discharge.

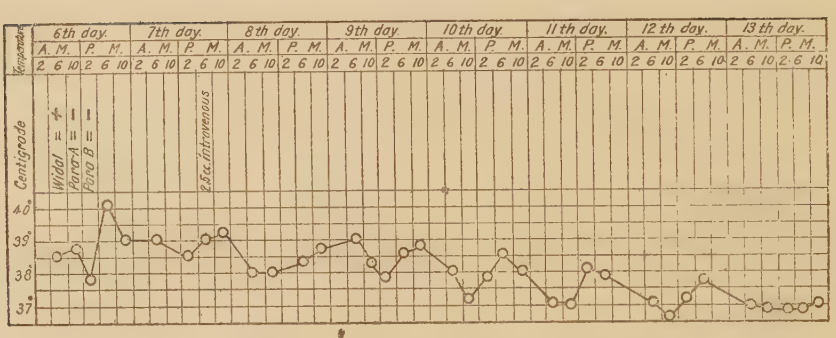

FIG. 10. Temperature chart of I. R. Showing benefited type of typhoid fever, treated with colloidal gold intravenously.

Symptomatology.—Letulle described the symptoms that appeared after the intravenous injection as consisting of a temporary rise in temperature preceded by chills, occurring from fifteen to forty minutes after injection, and followed by fall in temperature, sweats, general weakness, and alleviation of subjective symptoms. With my limited opportunities for observation, so far, I can only say that none of my cases developed chills. There is the possible exception of one patient who felt a slight sensation of chilliness, although his temperature showed a slight rise. Whether this difference of observation is due to racial insusceptibility of Filipino patients to the after effects of the treatment or whether the preparation on hand was defective are matters for future investigation.

Other symptoms observed were slight leucocytosis, temperature fall by lysis, remitting or intermitting temperature, and, rarely, fall by crisis. On the following day amelioration of the subjective symptoms may be marked.

Contraindications.—Letulle does not believe that delirium and high fever, tachycardia, small pulse, or albuminuria are contraindications for the intravenous injection. According to him the kidney continues to function well, for polyuria appears after injection. He observed neither intestinal hæmorrhage nor perforation.

It is not improbable that nephritis may be produced after a long-continued use of this preparation, because metals generally have an irritating effect upon the renal epithelium. This conception is supported by the experiment undertaken by Schöbl [1] in which he found marked nephritis in the kidneys of animals experimented upon with intravenous injection of colloidal silver preparation.

[1] Chief of the serum section of the Philippine Bureau of Science.

In conclusion, Letulle has stated that this preparation is antithermic, antitoxic, and without danger to the patient. He bases his conclusions on the disappearance of typhoid symptoms such as stupor, etc.

Complications.—The complications observed during the treatment are shown in Table XXII.

TABLE XXII.—*Complications before and during treatment.*

	Before treatment.	During treatment.
Lobar pneumonia	1	1
Intestinal hæmorrhage	0	[a] 2
Total	1	3

[a] One case developed two days after injection and the other six days after injection.

We see that there were three cases showing complications during the treatment, two of which were of intestinal hæmorrhage and one of lobar pneumonia. The fact that the cases of hæmorrhage did not appear early—that is, not until after two days following the injection—seems to show that the treatment did not induce this complication. The proportion of complications during the treatment of the series was found to be 20 per cent.

Mortality.—Out of fifteen cases in this series there were two deaths, a mortality rate of 13.3 per cent. Excluding one hopeless case, the mortality rate was 6.6 per cent. Autopsy findings of the two cases that were autopsied are shown as follows:

Autopsies (colloidal gold treatment).

File No. 2632: A. C.

Anatomic diagnosis: Lobar pneumonia; typhoid enteritis; parenchymatous degeneration of the viscera.

File No. 2603: H. G.

Anatomic diagnosis: Ulcerative enteritis, typhoid, healing; subacute splenitis; focal necrosis of the liver; chronic parenchymatous nephritis; chronic suppurative bronchitis; cloudy swelling of the liver and heart; trichuriasis; chronic pleurisy; emaciation.

Undoubtedly the two fatalities resulted from complications.

DISCUSSION

SPECIFICITY OF THE TREATMENT

Vaccine therapy has been studied extensively during recent years. The practical application of this biologic principle to the therapy of typhoid fever has its clue in the fundamental

phenomena of Ehrlich's side-chain theory. The undoubted success of prophylactic vaccine seemingly has given rise to unrestrained enthusiasm on the part of early investigators and has lead them to advocate its use for therapeutic purposes. This treatment, therefore, is the outcome of conscientious study in immunology and it is not a surprise that its followers should approach the question from that point of view.

Early in the history of vaccine therapy, Jenner(16) discovered the efficacy of the treatment. Fraenkel(7) employed it therapeutically for typhoid fever with good results. Wright(50) has advocated and emphazied the specificity of its action. Waitzfelder(48) has advanced the view that the treatment is "logical, scientific, and exact. It measures up to and beyond the expectant plan of treatment, the one in present use, in that it reduces mortality and shortens the period of illness." Rodet(41) employed immune typhoid serum injected intravenously in typhoid cases with excellent results. Ichikawa(15) used the intravenous injection of living sensitized typhoid bacilli with excellent results. Gay(9) and Garbat(8) in using sensitized vaccine have upheld the specific theory.

Mechanism of cure.—To explain the exact mechanism of cure with this form of treatment is exceedingly difficult, if not impossible. However, the interpretation of the mechanism of the action of vaccine has been given most serious consideration by other investigators, who have advanced hypotheses which we may review.

Thus, Garbat(8) believes that the curative effect of vaccine is due to the production of antiendotoxins as the result of stimulation by endotoxins that had been liberated into the bloodstream after the complement in the blood had combined with the bacilli. Ichikawa,(15) on the other hand, is inclined to the supposition that in the case of intravenous injection followed by chill, rise of temperature, and then crisis, we have phenomena of anaphylaxis, followed by antianaphylaxis. Gay and Chickering(11) believe that the cure is due to specific hyperleucocytosis and increased formation of antibodies in the blood circulation. Koranyi(20) has observed increased opsonic index in the blood after vaccine injection.

NONSPECIFICITY OF THE TREATMENT

It is the tendency among workers along these lines to interpret the complex action of vaccine therapy through phases of immunology and the specificity of its action. The specific theory has been regarded by the dissenters as untenable.

Rumpf(43) observed very early the nonspecificity of the treatment. By injecting *Bacillus pyocyaneus* in typhoid he could procure results quite as favorable as those secured by Fraenkel after the injection of typhoid bacilli. Kraus(21) used colon vaccine intravenously in similar cases, and gained equally good results. On the other hand, Kraus(21) used typhoid vaccine in cases of puerperal infections with similarly beneficial results. Even Ichikawa(15) found that his paratyphoid patients were benefited by the injection of typhoid vaccine. Furthermore, I have observed that the use of intravenous injections of plain killed typhoid vaccine in any form of arthritis produced remarkable results in the majority of cases. This is in agreement with the observations of Miller(28) and Thomas.(47)

Ludke,(26) in accordance with his view that bacteria constitute nothing more than a foreign protein in the animal economy of the host, employed another kind of protein of nonbacterial origin. He used deutero-albumose in typhoid, also with good results. Miller and Lusk(29) used 1 to 2 cubic centimeters of a 4 per cent solution of proteose intravenously in typhoid and observed similarly good results; 20 per cent of their cases so injected recovered by crisis after a single injection. Nolf(36) noted beneficial results in the use of peptone solution, injected either intravenously or intramuscularly. Saxl(44) successfully treated typhoid patients by intramuscular injection of sterile milk. In this study both peptone solution and sterile milk have been used by me with success.

There is evidence, however, that foreign protein is not the only substance used successfully in combating the disease. Thus Letulle and Mage,(25) Gay,(10) and Labbe(23) employed colloidal-gold preparations with good results. In this investigation colloidal gold was also used, and satisfactory results were observed; as may be seen, 20 per cent of the cases in my series aborted. Mitlander(30) used salt solution intravenously in three hundred cases of typhoid fever, preceded intravenously by 1 cubic centimeter of 20 per cent caffein and 10 per cent camphor, and marked improvement followed.

Mechanism of cure.—Investigators in other fields have questioned the specificity of vaccine therapy, a claim which they declare to be without foundation. To attack a disease with its own weapon, so to speak, seems rather paradoxical. For, then, this question has been asked—and it still remains without a satisfactory answer: Are we justified, in acute infectious disease, in introducing in any manner into a host more of the same toxin

from the effects of which he is already suffering? The view that there could be no possible stimulation of antibodies in a patient already suffering from acute infection with the typhoid organism has been given much thought in the effort to explain the mechanism of abortive cures, because it has been observed that there is no immediate change or increased concentration of antibodies in the patient after injection of vaccine.(18) In the case of pneumonia Cole,(4) at least, has not been able to produce immunity in animals rapidly enough to be of therapeutic value within six or seven days. The observations of other writers that there is a slight increase of Widal titer have been questioned on the ground that the Wright(28) opsonic index seems nowadays to be an unreliable guide, for the simple reason that the immunologist has no better method for determining immune body formation.

It has been observed in experimental work on animals that there is increased formation of nonspecific ferments, such as protease and lipase.(19) It is believed the protease has no action on bacteria, but that it hydrolyzes toxic protein into simpler and nontoxic substances, and that the lipase becomes lipoprotein against organisms in the final analysis. Whether the therapeutic application of other substances would mobilize the same nonspecific antiferments remains to be seen, although it is not improbable that such a thing may occur. That all improvements observed in bacteriotherapy might be wholly due to such specific action is, in my opinion, doubtful; because the frequent occurrence of relapses forms one of the objections to the belief that bacteriotherapy is specific.

Having set forth the two conflicting ideas in regard to the probable mechanism of cure, I am led to believe that the exact details of its mechanism are not fully known, and that in order to work out this problem a thorough coöperation between clinicians and laboratory workers is very necessary to allow justifiable interpretations of results.

Now, it might be asked, What form of therapy should be recommended in treating typhoid fever with the methods employed in this investigation? This is an exceedingly difficult, if not impossible, question to answer. It should be remembered that, in order to answer it satisfactorily, all the cases in each series should be placed under similar circumstances; that is, each series should consist of the same number of patients, who should be of the same sex and approximate age, and treatment should be administered simultaneously; the disease in each case should

be of equal degree of severity and occur during the same period of epidemic, and the same season of the year. When a physician has the opportunity to handle a large number of cases at one time, and observe as closely as possible the factors enumerated above, then and only then will a definite statement seem warranted. When laboring as I have done, under unfavorable circumstances, in which many of the ideal and necessary factors could not be obtained, to recommend a particular treatment as being the best would be premature, and unfair both to the expounders of the several systems of therapy and to the treatment itself. There are, however, some clinical grounds for maintaining the view that any form of treatment will have beneficial effects, provided a moderate reaction can be produced.

Let me lay emphasis on the principle of the early application of the treatment. The patients respond better during the early stage of the disease. In advanced cases the treatment is seldom productive of good results.

SUMMARY AND CONCLUSIONS

For a period of seven months, extending from August, 1917, to February, 1918, ninety-eight cases of typhoid fever were admitted to the medical department in the Philippine General Hospital. Twenty additional cases were admitted during that period, but these were not included in the present paper, because they were already either convalescent or in a dying condition on admission. These ninety-eight cases were all Filipinos, sixty-five males and thirty-three females, ranging in age from 14 years up. The majority of the cases belonged to the working class and, as a rule, exhibited low powers of resistance, consequent on "their mode of life, under-development, and limited diet." The mortality rate in these ninety-eight cases is 19.38 per cent; but, excluding the hopeless cases, the death rate was 10.22 per cent.

These cases were classified according to their severity, the cases being grouped in series. Each series naturally comprised an unequal number of patients, was treated at different periods of the epidemic, and received different kinds of treatment.

The treatment of the cases has been carried under two general groups; namely, (*a*) treatment with foreign protein, which includes sensitized and nonsensitized vaccine, peptone, and milk; (*b*) treatment with colloidal preparation, such as colloidal gold.

Table XXIII shows graphically the comparative results of the different treatments.

TABLE XXIII.—*Comparative results of different treatments.*

Variety of treatment.	Mode of administration.	Patients.	Total average duration of disease.	Deaths.	
			Days.	*Number.*	*Per cent.*
Sensitized vaccine	Intramuscular	30	24.1	6	20
Classical	Control	21	27.7	5	23.8
Sensitized vaccine	Intramuscular	10	27.7	3	30
Nonsensitized vaccine	Intravenous	9	20.0	1	11.1
Peptone	Intramuscular	5	17.2	0	0
Milk	do	8	21.0	2	25
Colloidal gold	Intravenous	15	22.0	2	13.3
Total		98			

In the investigation here discussed I have employed some of the treatments that I believe are stamped with the march of progress. After conscientious deliberation of the observations gained, both from my limited personal experience and from the experiences of other investigators in this field, I am inclined to believe that the nonspecific theory with regard to the action of vaccine as used in this investigation seems plausible, but that the exact details of the mechanism of action of each kind of treatment administered is not yet fully understood. However, it has been observed that a moderate reaction, following the administration of any of the treatments discussed, produced beneficial effects.

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ILLUSTRATIONS

TEXT FIGURES

FIG. 1. Temperature chart of B. Y. Abortive type of typhoid fever, treated with sensitized typhoid vaccine intravenously.
2. Temperature chart of E. N. Benefited type of typhoid fever, treated with sensitized typhoid vaccine intravenously.
3. Temperature chart of M. L. Benefited type of typhoid fever, treated with sensitized typhoid vaccine intravenously.
4. Temperature chart of N. C. Benefited type of typhoid fever, treated with sensitized typhoid vaccine intravenously.
5. Temperature chart of J. A. Abortive type of typhoid fever, treated with nonsensitized typhoid vaccine intravenously.
6. Temperature chart of C. G. Abortive type of typhoid fever, treated with nonsensitized typhoid vaccine intravenously.
7. Temperature chart of F. V. Abortive type of typhoid fever, treated with peptone intramuscularly.
8. Temperature chart of E. A. Illustrating the effect of intramuscular injection of milk.
9. Temperature chart of J. R. Abortive type of typhoid fever, treated with colloidal gold intravenously. Widal negative till discharge.
10. Temperature chart of I. R. Showing benefited type of typhoid fever, treated with colloidal gold intravenously.

THE VALIDITY OF THE NAME DISCOMYCES FOR THE GENUS OF FUNGI VARIOUSLY CALLED ACTINOMYCES, STREPTOTHRIX, AND NOCARDIA

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The nomenclature of the group of fungi the pathogenic members of which produce the various actinomycoses, so-called, has been the subject of a confusion that resulted from an unusual combination of circumstances. For some time it was a moot question whether the organisms were of bacterial or of fungous nature, in part because of erroneous conceptions of their morphology, which is complex and variable, and differs widely in different strains; even yet opinions differ as to whether or not the forms involved should be included in a single genus. One of the types, a saprophyte, *Streptothrix foersteri* Cohn, was for a time erroneously included in a genus of the higher bacteria, while the first pathogenic species described, *Actinomyces bovis* Harz, having been recognized as a fungus, was given a different generic name. The question was further complicated by the fact that both names had long before been employed for entirely different organisms. Since then some authors have held one invalid, some the other, and some have rejected both. Other names have been misapplied from time to time, while new ones have been proposed, the list now including a total of ten.

As is too frequently the case, the systematist and the pathologist have tended to ignore the work and the viewpoint of one another. Medical writers, who almost exclusively have been concerned with the study of these organisms and consequently the use of their names, have been very prone to choose these from the viewpoint of convenience and local custom rather than to recognize and adhere to the rules of nomenclature by which modern biologists are bound. On the other hand, botanists have overlooked or ignored—and they still do this—names and descriptions that have, in sincerity but without the formality customary with themselves, been published by medical writers. It is to consider the matter from both viewpoints in an effort to determine the actually correct designation that we have collaborated in a review of the vicissitudes of nomenclature that this group has undergone.

HISTORICAL

The phase of the confusion in which the characteristic of true branching in these organisms was not appreciated began in 1875, when Cohn(18) described, among others, two organisms that he made the types of new genera. One, which he named *Cladothrix dichotoma,* a colorless, filamentous plant found abundantly in water containing decomposing algæ, was characterized by a false branching that he compared to that of certain algæ; the other, which, apparently in ignorance of Corda's(19) previous use of the same generic name, he called *Streptothrix foersteri,* was a branching filamentous organism said to have been found first by Graefe and then by Foerster in concretions in the lachrymal canal of man and classified by Waldeyer as *Leptothrix buccalis.* Cohn did not accept this conclusion, the mode of branching suggesting the mycelium of fungi. It has been pointed out by Sauvageau and Radais(56) that the distinction between his *Cladothrix* and *Streptothrix* was so clear to Cohn that in the text he did not even compare them; furthermore, that his illustrations of them are quite distinct. They quote his diagnoses:

> *Cladothrix*—n. g. filamenta leptothricoidea tenerrima, achroa, non articulata, stricta vel subundulata, *pseudo-dichotoma.*
> *Streptothrix*—n. g. filamenta leptothricoidea tenerrima, achroa, non articulata vel anguste spiralia, *parce ramosa.*

In his summary, however, Cohn did not clearly differentiate them. According to Migula(44) he put them together among organisms showing false branching, although indicating uncertainty as to *Streptothrix* by an interrogation point:

> Zellfäden durch falsche Astbildung verzweigt.
> Fäden cylindrisch, farblos—*Cladothrix* Cohn.
> *Streptothrix?*

Cohn's later understanding of the morphology of the latter is evident from Israel's article cited below. However, it is hardly to be suspected from this arrangement that, as is now generally recognized, the dividing line between the higher bacteria and the lower fungi separates these two genera.

Bollinger, in 1876, demonstrated the fungous nature of the granules, or "drusen," from the lumpy jaw of cattle. Attempts at cultivation and inoculation had been without result. In the following year(10) he published a description in which he stated that Harz, to whom he had submitted fresh material, had concluded that the ray fungus (Strahlenpilz) belonged to the mold fungi and that it was related to *Botrytis, Monosporium,* and *Polyactis;* the name *Actinomyces bovis* was proposed for it.

Rivolta,(53) in 1878, changed the generic name to *Discomyces.* After amplifying the descriptions of the granules (corpuscoli discoidi) that he had made in 1868 and 1875, he said in part:

> E vero chi i corpuscoli discoidi compressi si risolvono in pennelli od in ventagli fatti di rami e ramoscelli, mar percio non si ponno dire *raggiati.* Questa parola in storia naturale ha un senso ben determinato. Il complesso dei dischi che ci rappresenta, se si voule, un micelio, non ha la forma raggiata, e per consequenza non si puo denominar raggiata o come venne detto *actinomyces,* e nemmeno si debbono indicare i danni o le lesioni che produce con la parola *actinomicosi.* Il solo nome conveniente, a mio avviso, sarebbe quello di *discomyces bovis,* e con la parola *sarcomicosi* si potrebbero indicare le lesioni che produce vel corpo del bue.

Harz(28) then published a separate description of the fungus, rejecting Rivolta's change.

Israel,(29) in 1878, used *Actinomyces,* but called attention to the similarity between the organism found in lesions in man and Cohn's *Streptothrix foersteri,* a resemblance which, he said, Cohn himself had confirmed. Perroncito,(49) although himself employing *Actinomyces,* quoted a communication from Professor Garovaglio, director of the Cryptogamic Laboratories of the University of Padua, in which its previous use by Meyen(42) was noted.

Rivolta(54) later declared that he was willing to accept *Actinomyces bovis,* but added that one could, nevertheless, form a group of pathogenic discomycetes containing: (1) *Actinomyces bovis* Harz; (2) *Discomyces pleuriticus canis familiaris* Rivolta; and (3) *Discomyces equi* Rivolta and Micellone. The second is now *Cladothrix canis* Rabe. (1898), and the third is known as a *Micrococcus* (*M. botryogenes* Rabe., *M. ascoformans* Johne, etc.). The first is, therefore, the only one of these organisms remaining in Rivolta's genus, as thus amplified by him, and is the type of the genus, both as originally published and as later amplified.

During this period systematists, who placed these organisms among the bacteria, denied the generic validity of Cohn's *Streptothrix.* Winter,(61) Zopf,(63) Schröter,(58) and Baumgarten(5) considered it to be a synonym of *Cladothrix.* Schröter included, in the same family, the genus *Actinomyces,* this being apparently the first recognition of Harz's organism in systematic classification. Baumgarten concluded that the ray fungi belonged among the pleomorphic higher bacteria in the genus *Cladothrix.* MacFadyean(39) agreed that the organisms of actinomycosis probably belonged to the Schizomycetes; he held that the occurrence of clublike elements in the granules was not of specific value because inconstantly formed.

Macé(37) also confused the genera, but in a new fashion. In 1888 he erroneously described for *Cladothrix dichotoma* a process of true branching and adopted(38) this generic name for the ray-fungus group. Sauvageau and Radais hold that he had never had the true *Cladothrix* under observation.

Affanassiew(1) at first called the organism of actinomycosis *Bacterium actinocladothrix,* but in the following year, 1889, Affanassiew and Schulz(2) gave the term *Actinocladothrix* generic rank. The only evidence that we have encountered of the use of this name by anyone else is the mention, without reference, of *"Actinocladothrix nocardi,"* in an article by Haass.(27)

De Toni and Trevisan, in Saccardo's Sylloge Fungorum,(20) accepted these organisms as belonging to the Schizomycetaceæ. In the Cladothriceæ: "Sporae (arthrosporae) in filamentis normalibus obvenientes. Filamenta pseudo-ramosa" they included *Sphaerotilus, Cladothrix,* and a genus that they called *Nocardia* Trevisan: "Filamenta evaginata. Arthrosporae transformatione cocci singuli ortae." In this genus they included *Streptothrix* Cohn, non Corda; *Actinomyces* Harz, non Meyen; and *Discomyces* Rivolta, five species being defined. The description of these organisms as falsely branching was, of course, erroneous.

In 1890 Almquist(3) and Gasperini(23) described certain organisms that they identified as species of Cohn's *Streptothrix.* Kruse held that these species fell, with the organism of actinomycosis, into Zopf's *Cladothrix* group. Rossi-Doria (55) soon described six new species of *Streptothrix* from the air and classed *Actinomyces bovis* Harz, which he is said to have renamed *Streptothrix actinomyces,* with them. Kruse(31) later also employed *Streptothrix,* differentiating it from *Cladothrix.*

From cases of actinomycosis in man Bostroem(11) repeatedly cultivated an organism that differed distinctly from that cultivated by Israel. He concluded that it belonged to the *Cladothrix* group of the Schizomycetes and pointed out that it might be related to, or even identical with, *Streptothrix foersteri* Cohn.

Grüber,(26) in 1891, described as *Micromyces hofmanni* an organism that subsequent authors have included in the group under discussion.

Sauvageau and Radais's(56) discussion of the confusion of Cohn's *Cladothrix* and *Streptothrix* has been referred to. They believed that the two were distinct; that *Cladothrix,* the most differentiated of the Bacteriaceæ, was falsely branched; and that *Streptothrix,* a true though very low hyphomycetous fungus,

to which the organism of actinomycosis belonged, showed true branching. They concluded that the latter really belonged to *Oospora* Wallroth (1831), but that, whether or not this was correct, it was necessary to discard *Streptothrix* Cohn because of Corda's use of this name in 1839. De Toni and Trevisan's description of *Nocardia* as falsely branching was incorrect, for although Nocard(47) had originally so described his "Bacille de farcin," Metchinkoff had found that it was a true-branching organism. Kanthack(30) accepted *Oospora* and created the name *Oospora indica* for the parasite of Madura disease, having demonstrated the identity of actinomycosis and of certain mycetomas. Lehmann and Neumann,(33) in 1896, introduced Mycobacterium as a family name for a group that they considered intermediate between the Hyphomycetes and the Schizomycetes, but rather more closely related to the former, and at first adopted *Oospora* as the generic name for the organisms under discussion.

Gasperini,(24) in 1894, proposed the use of *Actinomyces* to include the whole group, discarding *Streptothrix;* he listed eighteen species. Berestnew,(6) in 1897, accepted *Actinomyces* as valid and later(7) called attention to Gasperini's publication, which apparently had been overlooked. Lachner-Sandoval,(32) in 1898, pointed out the invalidity of *Oospora* in this connection and also adopted *Actinomyces.* Levy(34) reviewed the question, concluding that all the described types were generically related and that *Actinomyces* was the proper designation for them. He did not note Rivolta's original application of *Discomyces.* Lehmann and Neumann, in the second (1899) edition of their work, substituted the family name Actinomycetes Lachner-Sandoval for their own Mycobacterium, the pathogenic forms placed in the genus *Oospora* now becoming *Actinomyces.* This broader application of the term to the entire group is not now widely accepted, though Mallory,(40) after Gasperini, employed it tentatively, and Babes(4) and other German authors still use it.

Migula, in his earlier (1895) classification,(43) included these organisms among the higher bacteria, in his family Chlamydobacteriaceæ. He separated *Streptothrix* Cohn from *Cladothrix,* giving it a much modified diagnosis. In *Cladothrix* Cohn he included *C. bovis* (Harz) Migula (*Actinomyces bovis* Harz) and *C. foersteri* (Cohn) Schröter (*Streptothrix foersteri* Cohn), thus perpetuating the error of the earlier systematists. As already noted, Macé had adopted this generic name, although from a different viewpoint. Later(45) Migula modified this genus rad-

ically, removing those species that are now recognized to belong to the fungi.

Engler, in his Syllabus,(21) included Harz's organism in the genus *Sphaerotilus* as *"Sph. (Actinomyces) bovis,"* thus adding a new name to the list of synonyms. He had not revised this grouping in the fifth (1907) edition.

Discomyces Rivolta was shown to be the correct designation for the genus by Blanchard(9) who, stimulated by Levy's and Berestnew's articles, reviewed the question of nomenclature. In adopting this term he had changed his earlier opinion, for he had previously(8) employed *Nocardia.* His argument is based on accepted principles and should carry conviction. Previous to this the term had been practically ignored. It is true that Sheube(57) cites Nocard and then Blanchard as having advocated this term for *Discomyces (Streptothrix) indica,* but we have been unable to find any publication by Nocard in which it is used; on the other hand, in the third (1903) edition of Nocard and le Clainche's Maladies Microbiennes des Animaux,(48) *Actinomyces* is used in connection with actinomycosis and *Streptothrix* with "farcin du boeuf." Gedoelst(25) evidently accepted Blanchard's decision, for he designated the genus *Discomyces* Rivolta 1878, and the organism of actinomycosis *Discomyces bovis* (Harz 1877) Rivolta 1878. Stitt(59) is apparently the only American authority who has adopted this name. Brumpt(12) in a discussion of the mycetomas, used *Discomyces* and still subscribes to it, for in discussing organisms presented in 1913 by Pinoy(51) to the Société de Pathologie exotique (Paris) as *Nocardia* he used the former rather than the latter term. Manson,(41) in subscribing to Brumpt's classification of the mycetomas, also used the same nomenclature. Castellani and Chalmers(13) employed *Discomyces* in 1910, although they later discarded it.

A new name was introduced by Lignières and Spitz,(35) who called a subtype of this group *Actinobacillus.* In a later article(36) they acknowledged the strict propriety of Blanchard's argument in regard to the application of *Discomyces* to the general group, although they continued to use *Streptothrix.*

During this period certain German authors had adopted *Actinomyces* and *Streptothrix* as separate genera. This is exemplified by Petrusky's(50) classification in which they are placed in a family which he terms Trichomycetes. Wright(62) believed that *Actinomyces* should be retained for the organism of actinomycosis, which he emphatically maintained should be differentiated generically from other organisms of the group. He

rejected de Toni and Trevisan's objection that Meyen had given the name to another organism as an unreasonably strict interpretation of the principles of botanical nomenclature. On the other hand, for the rest of the group he rejected *Streptothrix* and accepted *Nocardia*. This subdivision of the group has been adopted in several American bacteriological textbooks. However, Chester(16) adopted the first classification of Lehmann and Neumann, except that *Oospora* was replaced by *Streptothrix* Cohn. Clements(17) included these organisms among the Schizomycetes; he followed Migula's earlier classification, except that *Nocardia* was substituted for *Streptothrix* Cohn, emend. Mig.

Foulerton(22) argued that, since the other names that had been proposed had dropped out of use, only *Streptothrix* and *Actinomyces* remained to be considered. He chose the former because, although Corda had used it in 1834, it had become uncertain to what particular organism the term had been applied; further, a committee of the Pathological Society of London in 1899 had recommended the term "streptotricosis" as the appropriate clinical designation for the infection. Musgrave and Clegg(46) acknowledged that *Nocardia* was probably more strictly correct, but "chiefly because of usage, and therefore somewhat arbitrarily, tentatively accepted *Streptothrix* * * *." They suggested the possible advantage of substituting an entirely new name, *Carteria* (*Carterii*, sic!), evidently hoping that by this means further controversy might be eliminated.

Pinoy has divided the group into *Nocardia*, which is to include most of the species, and *Cohnistreptothrix*, said to be designed to replace Cohn's invalid *Streptothrix*. The article that contains his argument is probably one by Pinoy and Morax,(52) which is not available to us. According to Chalmers and Christopherson(15) the characteristics of this genus are preference for anaërobiosis, difficulty of cultivation, and nonproduction of arthrospores; in it they include Cohn's *Streptothrix foersteri* and Israel's *Actinomyces* from man (*Streptothrix israeli* Kruse, 1896).

Vuillemin,(60) as a result of the adoption by the 1910 meeting of the International Botanical Congress at Brussels of a program for the next congress that included the determination of the point of departure for the nomenclature of the Schizomycetes and the elaboration of lists of *nomina conservanda* for these organisms, has recently published a revised generic classification, which was intended to be submitted for consideration at the scheduled London (1915) meeting of the congress. In an appendix to this work he includes the family Microsiphones,

composed of genera to certain of which organisms such as the "bacillus" of tuberculosis and the "bacillus" of diphtheria are assigned. For the genus under discussion he adopts *Nocardia* Trevisan, which he recommends for inclusion in the list of *nomina conservanda.* He says, in effect, that systematic botany need not concern itself with the "medical genus" *Discomyces,* in which Rivolta combined, without mycological significance, the parasites of actinomycosis, botryomycosis, and canine pleurisy, nor with the genus *Cohnistreptothrix,* founded by Pinoy upon bacteriological grounds, and that *Nocardia* remains the valid name for the genus. As the Congress did not meet in 1915, Vuillemin's recommendations have not yet been acted upon.

Castellani and Chalmers have substituted, without discussion, *Nocardia* for *Discomyces* in the second edition of their work.(14) They remark that there are many points in favor of Pinoy's subdivision of the genus, which probably would be soon generally accepted.

The most recent discussion of this question is in a study of actinomycotic mycetoma by Chalmers and Christopherson,(15) who enumerate sixty-three species of *Nocardia* and eleven of *Cohnistreptothrix.* They argue the validity of *Nocardia* on the grounds: (1) that it is the oldest name against which no objections can be raised; (2) that it has been formally adopted by the Botanical Section of the First International Congress of Pathology;[1] (3) that there are objections to the other names in use. They eliminate *Discomyces,* because:

> *Discomyces* was used by Rivolta in 1878 merely as a trivial name, and though it has not been applied to any other genus, still the word *Discomycetaceae* was introduced in 1836 by Fries for a large fungal group and has come into general use, and therefore has the double claim of priority and general use, and as its type genus should bear the name *Discomyces,* confusion is bound to arise if the same term is retained for the generic name of Bollinger's organism.

The value of these objections will not be discussed at this point.

SUMMARY

The source and present status of the various names that have been applied to the organisms of this group may be summarized as follows:

Cladothrix Cohn (1875). This name was used as generically

[1] This probably refers to the Congrès international de pathologie comparée, organized by the Société de pathologie comparée, the first and as yet only meeting of which was held at the Faculty of Medicine, University of Paris, in 1912.

valid over *Streptothrix* Cohn (1875) by Winter (1884) and other systematists, the distinction not being understood. The organism of actinomycosis was informally assigned to this genus by Bostroem, Baumgarten, and others, formally by Migula (1895). *Cladothrix* Cohn is a different type of organism and the name is, therefore, inapplicable.

Streptothrix Cohn (1875), non Corda (1839). This name was applied by Cohn to a true-branching organism but was placed in his classification as doubtfully synonymous with *Cladothrix*. The resemblance of the fungus of actinomycosis in man to it was noted by Israel (1878); the name was adopted in 1890 by Almquist and by Gasperini for nonpathogenic air organisms, and in 1891 it was adopted by Rossi-Doria for that of actinomycosis.

For a time this was probably the most widely used name for the group. At present it is frequently applied to the group minus the organism of actinomycosis. It is unquestionably invalid in either connection because previously applied by Corda (1839) to an organism distinct from those under consideration.

Actinomyces Harz (1877) non *Actinomyce* Meyen (1827). This name was applied by Harz to the fungus of "lumpy jaw" of cattle, by Gasperini (1894) to the entire group, replacing *Streptothrix*, and accepted in this application by Berestnew (1897), Lachner-Sandoval (1898), and others.

It is now used by many writers, particularly the German and the American, as a valid name for the organism of actinomycosis only; it is seldom used in the more general sense. As is shown below, this name is invalid because published in connection with an entirely different organism by Meyen (1827).

Bacterium Ehrenberg 1830. Affanassiew (1888) is said for a time to have called the organism of actinomycosis *Bacterium actinocladothrix*. This designation is manifestly inapplicable.

Actinocladothrix Affanassiew and Schultz (1889). This was proposed as a generic name by Affanassiew and Schultz in 1889 for the organism of actinomycosis. It did not receive the consideration to which, being of even date with the widely adopted *Nocardia*, it was certainly entitled.

Micromyces Grüber (1891). This name was applied by Grüber to an *Actinomyces*-like organism that he called *M. hofmanni*. This organism cannot be distinguished from the general group under consideration.

Oospora Wallroth (1833). This was adopted by Sauvageau and Radais (1892), who concluded that the group belonged to Wallroth's genus. Lehmann and Neumann (1896) adopted this view, but later abandoned it, Lachner and Sandoval (1898)

having shown that *Oospora* Wallroth is an organism entirely different from those under discussion.

Sphaerotilus Kuetz. (1883). This name was adopted by Engler for the group including *Cladothrix (Streptothrix) foersteri* Cohn, with which he included *Actinomyces bovis* Harz. This disposition was undoubtedly due to the old misapprehension as to the distinction between *Cladothrix* and *Streptothrix.*

Actinobacillus Lignières and Spitz (1902). This name was applied by Lignières and Spitz to a supposed subtype of this group. The distinction has not been recognized, and by most authors the name is considered a synonym.

Carteria Musgrave and Clegg (1908). The adoption of this new name (as "Carterii") was tentatively suggested by Musgrave and Clegg as possibly advantageous for the purpose of avoiding further controversy, although they did not definitely advocate this highly informal procedure.

Nocardia Trevisan (1889). This name was adopted by de Toni and Trevisan to cover the entire group. Blanchard used it for a time in its original application and Wright (1894) adopted it for nonpathogenic strains only. As many other authors use it in one sense or another, of late it has gained much prestige. Vuillemin, and Chalmers and Christopherson have recently adopted it for the entire genus.

The validity of this name we deny on the grounds indicated in the discussion that follows.

Discomyces Rivolta (1878). This name was definitely substituted by Rivolta for *Actinomyces,* with the change of name of Bollinger's fungus to *Discomyces bovis.* It was practically ignored until Blanchard (1900) argued its priority over *Nocardia.* Subsequently Gedoelst, Brumpt, Manson, Stitt, and for a time Castellani and Chalmers, adopted it.

As indicated in the discussion this name is clearly valid over *Actinomyces* and all subsequent names.

DISCUSSION

Before considering the validity of *Discomyces* for this group over *Nocardia* and *Actinocladothrix,* it is necessary to emphasize the invalidity of two older terms that have gained general recognition.

Streptothrix Cohn (1875) is invalidated by *Streptothrix* Corda (1839). It has been argued that there is doubt as to what organism is referred to by Corda's name. This is apparently not the case for in recent years several new species have been described in Corda's genus. *Streptothrix* Corda is unques-

tionably a valid, recognized genus, and *Streptothrix* Cohn must fall.

Actinomyces was used by Harz with but a very limited knowledge of the organism to which he applied it, evidently without suspecting its possible relationship to Cohn's *Streptothrix foersteri* and probably without being aware of Meyen's use of the name. Whether or not this newer application is valid, as most writers seem at least tacitly to agree, depends on the validity of its preëmption by Meyen. That it is valid is evident from the following transcription from the original publication:

Actinomyce

Sporidochia, cellulis hyalinis simplicibus enormiter et multipliciter ramificantibus sporis impletis, substantiae uniformi gelatinosa hyalina induta.

Actinomyce Horkelii

R. forma irregulari sphaeroidea, gelatinosa duritie ad basin augente usque ad consistentiam cartilaginosam, colore hyalino-subcoeruleo. Hab. in pinguedine et pleuris animalium aquae submersis, autumno prope Coloniam Agrippinam.

Zum Schlusse wage ich noch, etwas über das beginnende Wachsthum dieses Pilzes zu sagen. Der Pilz ist nicht eine Krankheitsform eines Organismus, sondern er ist ein eigener Organismus, ein eigenes Leben unabhängig von seinem Mutterboden, aber dennoch von demselben beschränkt.

It is to be noted that Meyen used the name *Actinomyce*. While by some the use of this form might conceivably be argued not to invalidate *Actinomyces*, the derivation of the two is identical, and the argument cannot hold. *Actinomyce horkelii* Meyen is now an organism of uncertain status. Although it was described by Meyen as a fungus, the description apparently applies to one of the colonial Cyanophyceæ. The genus is not recognized in either mycological or algological literature. However, the description of both the genus and the species is indisputably valid, and in the present connection the question of its identity is unimportant. In being validly published, it invalidates the further use of the same name for another group of organisms in the plant kingdom.

From the foregoing it is evident that by the accepted principles of botanical nomenclature both of these names are preoccupied. To deny on this ground either of them and yet accept the other, as has been done, is inconsistent. Recommendation of "streptotricosis" by a committee of the Pathological Society of London cannot be accepted as competent to validate *Streptothrix*, nor can the adoption by the Botanical Section of the First International Congress of Pathology validate *Nocardia*. It is true

that through formal adoption by the proper bodies *nomina conservanda* are validated; however, neither of the societies mentioned has authority to do this in botany.

There remains to be considered, then, the name next applied to this genus. This was published by Rivolta, in 1878, when he proposed, definitely and distinctly, to substitute *Discomyces* for *Actinomyces*.[2] The reason for which he did this is an invalid one; he believed that *Actinomyces* was not properly descriptive of the organism and, unhampered by rules of nomenclature, adopted *Discomyces* as preferable in this respect. He was undoubtedly not aware of the fact that the former had been used before, but it is on this ground rather than that on which he advanced his new name that *Discomyces* is valid.

Vuillemin, and more recently Chalmers and Christopherson, in advocating *Nocardia* as the valid generic name, hold that Rivolta's use of *Discomyces* was trivial and without botanical significance. We do not agree with this argument, which is clearly refuted by Rivolta's original paper. Here he distinctly proposes *Discomyces bovis* as the name for the organism called *Actinomyces bovis* by Harz in a manner that must be acknowledged as valid from the viewpoint of botany, even though it is not in conventional form and was advocated on irrelevant, inadequate grounds. Therefore, it is in no sense a "medical genus," as Vuillemin asserts. The fact that subsequently Rivolta erroneously referred other organisms to this genus has no bearing on the case. His original application of it was to the organism of Bollinger and Harz alone, which is, therefore, the type of the genus. Nor does the fact that, to propitiate Harz, Rivolta later agreed to accept *Actinomyces* affect the question. As Blanchard pointed out, a name once introduced

[2] The definite manner in which this substitution was made has been generally ignored, possibly because of the inaccessibility of the original paper, it having been published in an Italian veterinary journal. The rarity of this publication is exemplified by the difficulty that we have had in consulting it. The 1878 volume of Clinica Veterinaria was found to be missing from the set of this periodical in the Surgeon-General's library in Washington, whereupon Mr. P. L. Ricker, of the United States Department of Agriculture, to whom we had applied, requested it from Mr. B. B. Woodward, librarian of the British Museum. He, not finding the publication in that library, forwarded the request to Mr. F. Bullock, of the Royal College of Veterinary Surgeons, through whose kindness a separate of Rivolta's article was forwarded to Washington, where photostat reproductions were made, one of which Mr. Ricker forwarded to us. To these gentleman we express our appreciation.

is no longer the property of its originator to withdraw or modify at will.

Finally, to argue, as do Chalmers and Christopherson, that Discomycetaceæ, a group name, invalidates *Discomyces* as a generic name in the connection in which Rivolta used it, on the ground that the type genus of Fries's Discomycetaceæ, published in 1836, should bear the designation *Discomyces*, indicates an erroneous conception of the principles of nomenclature and priority in technical names; a family name such as Discomycetaceæ cannot invalidate the generic name *Discomyces* any more than a generic name can invalidate a similar specific name. This generic name was new with Rivolta, and there is no valid objection to its adoption in taxonomy.

Nocardia is no longer to be considered. Both it and *Actinocladothrix* of Affanassiew and Schultz, the publication of which seems to have been completely ignored, were proposed eleven years later and fall as synonyms of *Discomyces* Rivolta (1878), which genus is typified by *Discomyces bovis* (Harz) Rivolta.

The question of division of the group is a different matter. It is our conception that the group, exhibiting as it does wide differences among the species, should be subdivided. However, neither the characters upon which separation was advocated by earlier writers (granule formation in tissues, club-ended filaments in the granules), nor those advanced by Pinoy (difficulty of cultivation, anaërobiosis, absence of arthrospores), seem to be convincing for generic distinction. Granules may be formed in animal lesions by a variety of these organisms, and club formation is a variable feature even in typical actinomycosis. Anaërobiosis and difficulty of cultivation are not generically distinctive botanically, nor so considered for other groups of microörganisms from the bacteriological viewpoint. Furthermore, these features characterize both the strains described by Israel and those studied by Wright. Should it appear desirable to divide the genus, this will probably be done on the basis of morphologic rather than metabolic differences.

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IONTHA IDA, A NEW PHILIPPINE NOCTUID

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ONE PLATE

LEPIDOPTERA: HETEROCERA

NOCTUIDÆ

QUADRIFINÆ[2]

Genus IONTHA Doubleday[2]

Iontha ida sp. nov.

Male.—Head dark brown; eyes nearly black; apical segment of palpus ringed with ochraceous scales at middle, antennæ reddish; body and wings dorsad and ventrad a faded, dark, yellowish brown, the wings above darker apicad and highly bronze-iridescent; a darker reniform, median, subcostal spot on fore wing circumscribed by a very few heliotrope scales and punctured centrad by one or two ochraceous scales; a faint brown zigzag line connects it with caudal margin, at which point is a very tiny patch of heliotrope scales; a dark brown dot, similarly circumscribed, five-eighths of the distance from base of wing to reniform spot; a submarginal row of six dark brown dots from apex to anal angle on outer margin. Each of these dots lies within an area of diffused heliotrope scales forming more or less of a circle around the individual spot but all running together to form an indistinct marginal band; ectad of this a thin, dark brown wavy line; marginal cilia alternately white and brown, the white being subjacent to the respective submarginal dots. Hind wings with a similar pale heliotrope band containing about five distinct, dark brown dots, almost obsolete at outer angle but growing more marked toward anal angle, which is much produced and lobed laterad and somewhat recurved (See Plate I, fig. 1). Fore wings ventrad uniformly brown, irrorated with heliotrope on apical area and with a

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[2] *The Entomologist* (1842), 298, 1 figure.

subcostal, ill-defined, darker brown, transverse spot beyond median area; marginal cilia as on dorsal surface. Hind wings ventrad slightly darker iridescent brown, strongly irrorated with heliotrope scales over costal and outer areas and with a row of linear, heliotrope dots extending from costa obliquely across the cephalic two-thirds of wing to a line from base to anal lobe. Of these dots the costal is most prominent and almost white. These dots have faint counterparts on the dorsal surface but the latter extend farther toward inner margin, which is heavily fringed with pale brown cilia; the basal, median, and inner areas of the hind wing and the basal area of the fore wing on their dorsal surfaces are heavily clothed with long hair of a golden brown hue. Tegulæ concolorous with wings.

Ventral surface of thorax and abdomen whitish ochraceous, growing darker toward apex of abdomen, so that sixth abdominal sternite has a diffused, longitudinal, brown, median stripe, and seventh is nearly all brown, with sublateral suffusions of heliotrope. Anal tuft nearly as long as abdomen, very dark iridescent brown, the iridescence more marked ventrad. Fore and mid legs with femora and tibiæ brown ectad, creamy white entad; tarsi brown with creamy white at articulations. Hind legs uniformly brown, very hirsute, the tibiæ and tarsi having very dark brown hairs, lying in the same plane, lengthening toward apex of tibia and growing shorter toward apex of tarsus.

Total length (including palpi and anal tuft), 48 millimeters; width of head, 5.25; length from front of head to apex of abdomen, 30; length of anal tuft, 18. Expanse of wings, 60 millimeters; length of fore wing, 28; length of hind wing, 23; length of antenna, 20; length of hind leg, 23; hind tibiotarsal length, 17; tibial fringe, 4.

LUZON, Laguna, Los Baños, P. I.; July 8, 1915 (*Charles S. Banks*). A single specimen flew into my house at night and, rapidly half crawling, half flying, around on the table, was captured without injury.

Type, No. 18468, male, in the entomological collection, College of Agriculture, Los Baños, P. I.

This species is closely related to *Iontha umbrina* Doubleday,[3] from which it differs most strikingly in having the anal angle of the hind wing lobed and much reflexed ectad; in having the heliotrope submarginal band extended to anal angle on hind wings and equally as well marked as on the fore wings, and in the alternately pale and dark brown fringe of the fore wings.

[3] *The Entomologist* (1842), 298, 1 figure.

Its very striking appearance differentiates it at once from all other noctuids that I have seen, and its graceful actions are not easily forgotten when once they have been witnessed.

I dedicate this beautiful insect, the first and only one of its genus ever taken in the Philippines, to my mother, Ida Randolph Banks.

Its closest ally, *Iontha umbrina* Doubleday, is recorded from Sylhet, in northern India, by all authors and from Singapore by Swinhoe. Hampson [4] gives Borneo in addition but, as he cites no collector, this may be an error.

[4] Fauna of British India, Moths (1894), 2, 541, fig. 301.

ILLUSTRATION

PLATE I

Iontha ida sp. nov., natural size. *a*, dorsal aspect; *b*, ventral aspect; *c*, lateral aspect.

PLATE I. IONTHA IDA SP. NOV., NATURAL SIZE.

THE SOCIAL BEES OF THE PHILIPPINE ISLANDS

By T. D. A. Cockerell

(*University of Colorado*)

The social bees of the Philippines are included in three families, easily distinguished as follows:

Anterior wings with reduced venation; small, stingless bees.... Meliponidæ.
Anterior wings with three submarginal cells; larger bees, with sting in females and workers..... 1.
1. Eyes hairy; marginal cell long (honey bees).....Apidæ.
Eyes naked; large hairy bees (humble bees)..... Bombidæ.

MELIPONIDÆ

A large family of social bees, abundant in the tropics of both hemispheres, but absent from the temperate parts of the northern hemisphere, though extending south of the tropics in Australia. The only Philippine genus is the following:

Genus TRIGONA Jurine

The record of *T. læviceps* Smith is probably erroneous. The following species are known to occur:

Base of abdomen bright ferruginous, the following segments intense black, abruptly contrasting ..... palavanica Cockerell.
Abdomen not thus bicolored..... 1.
1. Larger, the worker 6.5 to 7 millimeters long; abdomen ferruginous. luteiventris Friese.
Smaller, worker about 3.75 millimeters long; abdomen dark. biroi Friese.

Trigona palavanica Cockerell.

Trigona palavanica Cockerell, Ann. & Mag. Nat. Hist. (1915), VIII, 16, 2.

Palawan, Puerto Princesa (from *Baker*).

Trigona luteiventris Friese.

Trigona luteiventris Friese, Résult. L'Expéd. Sci. Néerlandaise à la Nouvelle-Guinée. Leiden (1900), 5, Zoologie, 358.

Palawan; also Perak.

Trigona biroi Friese.

Trigona biroi Friese, Termés. Füzetek (1898), 21, 429.

Philippines and New Guinea, according to Friese. Philippine Islands (*C. R. Jones*).

LUZON, Los Baños (*Baker*): Bataan, Lamao (*P. J. Wester*), at flowers of *Nipa fruticans*, February 26, 1916.

I take the opportunity to make known some species obtained by Professor Baker in Penang and Singapore:

Trigona ambusta sp. nov.

Worker.—Length, 8.5 millimeters; anterior wing, 8 millimeters. Head large, shining black, the clypeus ferruginous, broadly suffused with dusky above and at sides; antennæ dark, except basal third of scape, which is bright ferruginous; mandibles simple; front with fine brown pruinose tomentum; a band of stiff black hair behind ocelli; mesothorax and scutellum ferruginous, the latter with two dark marks and the mesothorax with dusky lines anteriorly; surface of mesothorax with very short thin rich fulvous tomentum, and anteriorly with black hairs; scutellum with short stiff black hairs; metathorax hairy at sides, but the broad central portion polished, shining black; pleura black in middle, reddish around sides, and red below; tegulæ castaneous; wings fuliginous, with the apical field broadly reddish hyaline; stigma and nervure dusky reddish; legs black, the coxæ and trochanters red; abdomen black (extreme base of first segment red), narrow, compressed, shining, with dark hair at apex.

SINGAPORE (*Baker 9067*). Allied to *T. lacteifasciata* Cameron, from Borneo, but with black femora, basal part of wings dark, and other differences. It is also related to *T. thoracica* Smith, differing in the color of the wings, which Smith describes as flavo-hyaline in his species.

Trigona atripes Smith, a variety differing a little in the color of the legs, comes from Penang Island (*Baker 9068*). The following species with black head and thorax were obtained by Baker on Penang or at Singapore:

Mesothorax dull, bordered with fulvous hair (Penang).
fulvomarginata sp. nov. (9073).
Mesothorax not thus bordered ..... 1.
1. Small species, with red scape ..... 2.
Larger species; scape black, at most red at extreme base ..... 3.
2. Tegulæ ferruginous (Singapore) ..... valdezi sp. nov. (9074).
Tegulæ black (Penang) ..... penangensis sp. nov. (9075).
3. Larger; transverse-cubital nervures barely indicated (Singapore).
busara sp. nov. (9072).
Smaller; transverse-cubital nervures distinct ..... 4.
4. Scutellum bare (Penang) ..... bakeri sp. nov. (9069).
Scutellum conspicuously hairy (Singapore).
itama sp. nov. (9071=type; 9070).

Trigona fulvomarginata is very close to *T. ventralis* Smith and has the abdomen whitish at base and beneath as in *ventralis*. It differs by the dusky wings and the bright fulvous hair bordering mesothorax and scutellum. The scape is pale at the extreme base, and the face has short grayish white hair.

Trigona valdezi and *penangensis* belong to the *iridipennis* and *biroi* series. They differ at once from *iridipennis* by the dusky wings. The wings of *penangensis* are less produced apically than those of *iridipennis*, and the abdomen is pure black. *Trigona biroi* is larger than *penangensis* and has darker wings. *Trigona valdezi* is 5 millimeters long, but *penangensis* is not over 4. The abdomen of *valdezi* is brown, palest basally; that of *penangensis* is pure black. *Trigona valdezi* is also close to *T. læviceps* Smith, but differs by the black femora, tibiæ, and middle and hind basitarsi.

Trigona busara is about 7 millimeters long, robust, with dusky wings; stigma and nervures dilute sepia; face and front covered with cinereous pile; scutellum with much black hair; pleura with mouse-colored tomentum above, grading into cinereous below; legs black.

Trigona bakeri and *T. itama* are much alike, about 6 millimeters long, with dilute fuliginous wings, noticeably darker than those of *T. busara*. The front mesothorax and abdomen are shining, but in *bakeri* the mesothorax is extremely smooth and polished, in *itama* distinctly dullish. The legs are black in both. *Trigona busara, bakeri,* and *itama* all have the abdomen shining black.

The following, described by Smith from Singapore, are not represented in the collection: *Trigona fimbriata, T. læviceps,* and *T. thoracica*. Smith described four others from Mount Ophir; one of them (*T. atripes*) was found on Penang. It is a fulvous insect, quite unlike the others here described.

APIDÆ

I recognize only a single genus, though the segregates proposed by Ashmead may be considered subgenera.

Genus APIS Linnæus

Large species, workers about 16 to 18 millimeters, with eyes somewhat converging above; second recurrent nervure joining third submarginal cell very near its apex..... Subgenus Megapis Ashmead.

Medium-sized species, typified by the common honey bee; second recurrent nervure not going so near end of third submarginal cell.
Subgenus Apis Linnæus.

Small species, workers about 8 millimeters..... Subgenus Micrapis Ashmead.

Subgenus Megapis Ashmead

Basal half of abdomen clear ferruginous..... dorsata Fabricius.
Abdomen black, with a band of white tomentum at base of second segment. binghami Cockerell.

Subgenus Apis Linnæus

Length of worker, 10 to 13 millimeters; labrum black..... mellifera Linnæus.
Length of worker, 9 to 11 milimeters; labrum and more or less of clypeus pale reddish..... indica Fabricius.

Subgenus Micrapis Ashmead

One species; labrum and clypeus dark..... florea Fabricius.

Apis dorsata Fabricius.

Apis dorsata Fabricius, Ent. Syst. (1793), 2, 328.

Listed by Ashmead.

Apis binghami Cockerell.

Apis binghami Cockerell, Canad. Entom. (1906), 166 (*zonata* Smith, preoccupied).

Luzon, Mount Banahao (*Baker*); Bacoor (*P. L. Stangl*); reported by Ashmead.

Apis mellifera Linnæus.

Apis mellifera Linnæus, Syst. Nat. (1758), **10**, 576 (later called *mellifica* by Linnæus).

Presumably occurs only as a domesticated insect.

Apis indica Fabricius.

Apis indica Fabricius, Ent. Syst. Suppl. (1798), 274.

Luzon, Los Baños. Mindanao, Dapitan (from *Baker*). The Philippine specimens seen by me have the abdomen banded conspicuously with black, and belong to the race *nigrocincta* Smith. The form *unicolor* Latreille, with black abdomen, has been reported by Ashmead from Cagayan and Alcala. Ashmead reports *nigrocincta* from Manila (*Stanton*).

Apis florea Fabricius.

Apis florea Fabricius, Mant. Ins. (1787), 1, 305.

Said to occur in the Philippines. I have none from the Islands.

BOMBIDÆ

Genus BOMBUS Latreille

Body covered with pale hair, some black intermixed on abdomen; wings hyaline ..... **mearnsi** Ashmead.

Hair of head nearly all black, of thorax above black, but on pleura fulvous; abdomen with first two segments yellow-haired, the others with black; wings fuliginous..... **irisanensis** Cockerell.

Bombus mearnsi Ashmead.

Bombus mearnsi ASHMEAD, Proc. U. S. Nat. Mus. (1905), 28, 959; COCKERELL, Ann. & Mag. Nat. Hist. (1905), VII, 16, 393.

MINDANAO, Mount Apo, 6,000 feet (*E. A. Mearns*). Type in United States National Museum.

Bombus irisanensis Cockerell.

Bombus irisanensis COCKERELL, Ann. & Mag. Nat. Hist. (1910), VIII, 5, 416.

LUZON, Benguet, Irisan (collector unknown). Type in British Museum. Structurally resembles *B. sumatrensis* Ckll., from Sumatra, but the colors are quite different. *Bombus* is known from Java (*B. rufipes* Lep.), Sumatra (*B. senex* Snell., *B. rufipes melanopoda* Ckll., and *B. sumatrensis* Ckll.), and the Philippines; but not yet from Borneo.

THE PHILIPPINE BEES OF THE FAMILY NOMADIDÆ

By T. D. A. COCKERELL

(*University of Colorado*)

The Nomadidæ are represented in the Philippine Islands by species of *Nomada* Scopoli, a genus very widely spread over both hemispheres. The Philippine species are all small and look like small wasps. They are parasitic, presumably in the nests of the various species of *Halictus*. Those so far recognized may be separated thus:

Genus **NOMADA** Scopoli

Anterior wings with two submarginal cells ..... 1.
Anterior wings with three submarginal cells ..... 4.
1. Mesothorax of female black ..... pervasor sp. nov.
Mesothorax of female red, at least at sides ..... 2.
2. Front black, except along orbits ..... attrita sp. nov.
Front red ..... 3.
3. With a yellow spot at each side of second abdominal segment. makilingensis Cockerell.
Without such yellow spots ..... palavanica sp. nov.
4. Males ..... 5.
Females ..... 6.
5. Third antennal joint short, little longer than broad.* banahaonis Cockerell.
Third antennal joint long, much longer than broad. mindanaonis Cockerell.
6. With a conspicuous yellow spot at each side of second abdominal segment. exheredans sp. nov.
Without such spots ..... 7.
7. Mesothorax black, at most with a little red at sides ..... 8.
Mesothorax red, with at most a blackish discal shade ..... 9.
8. First abdominal segment with a broad red band; hind tibiæ red. concessa sp. nov.
First abdominal segment black, with small red spots; hind tibiæ black, with the ends red ..... bakeri Cockerell.
9. Hind margins of abdominal segments suffused with dusky; flagellum dull red beneath ..... lusca Smith.
Abdomen usually clear red; flagellum black ..... mindanaonis Cockerell.

* The second joint is very small and partly hidden in the apex of the first, so it is possible to mistake the third for the second.

Nomada pervasor sp. nov.

Male (*type*).—Length, about 6 millimeters; black, with the following chrome-yellow markings: Basal part of mandibles (which have no inner tooth), labrum, lower margin of clypeus, small triangular areas at lower corners of face, claviform streak above eyes, scape in front except at base (but suffused with reddish), tubercles, tegulæ (except a dark spot), scutellum (which is bilobed), apical part of femora (especially in front), tibiæ (except a dusky mark, and on hind tibiæ the middle half dark, except a stripe behind), anterior tarsi and middle basitarsi, large spots on each side of second and third abdominal segments, smaller (paler) marks on fourth, a briefly interrupted band on fifth, and a broad complete band on sixth. Middle of face and a transverse mark on pleura reddish; apical plate of abdomen pale ferruginous, very deeply notched; flagellum long, black; third antennal joint a little longer than fourth; mesothorax very densely and coarsely punctured; wings with only two submarginal cells, the second transverse-cubital nervure lacking; apical part of wings strongly infuscated; basal nervure going far basad of transverse median; abdomen polished and shining, first segment entirely black.

Female.—Similar to the male in most respects; a large, quadrate, subapical yellow patch (more or less emarginate anteriorly) on abdomen.

LUZON, Benguet, Baguio (*Baker*), 1 male, 3 females.

Nomada attrita sp. nov.

Female.—Length, a little over 4 millimeters; differing from *N. makilingensis* thus: Smaller; front black, with a red band along each orbit; mesothorax with middle third or rather more black, lateral parts dusky red; abdomen beyond first segment suffusedly blackened.

MINDANAO, Butuan (*Baker* collection).

Nomada makilingensis Cockerell.

Nomada makilingensis COCKERELL, Ann. & Mag. Nat. Hist. (1915), VIII, 15, 263.

LUZON, Laguna, Mount Maquiling (*Baker*).

Nomada palavanica sp. nov.

Nomada mindanaonis, variety, COCKERELL, Ann. & Mag. Nat. Hist. (1915), VIII, 15, 4.

Female.—Length, about 5.5 millimeters; differing from *N. makilingensis* by the absence of yellow spots on second abdominal segment, the black flagellum, and the dusky hind legs.

PALAWAN, Puerto Princesa (*Baker* collection). I was evidently in error in regarding this as a variety of *N. mindanaonis;* the first recurrent nervure joins the second submarginal cell much nearer the base than in that species.

Nomada banahaonis Cockerell.

Nomada banahaonis COCKERELL, Ann. & Mag. Nat. Hist. (1915), VIII, 15, 264.

LUZON, Mount Banahao (*Baker*). The male varies in size; length, 4.5 to 6 millimeters.

Nomada mindanaonis Cockerell.

Nomada mindanaonis COCKERELL, Ann. & Mag. Nat. Hist. (1915), VIII, 15, 265.

MINDANAO, Dapitan (type locality); Davao. PALAWAN, Puerto Princesa. All from Baker. The tegulæ of the male vary to red. The females vary, Davao specimens showing more or less dusky shades on the abdomen. It becomes difficult to separate females of this species from *N. lusca,* but I have no male of *lusca* from Luzon. It is quite possible that *N. mindanaonis* is only a local race of *lusca,* differing in average rather than absolute characters. The type is a male.

Nomada exheredans sp. nov.

Female.—Length, about 5.5 millimeters; red with blackish markings, the second abdominal segment with a large round yellow spot on each side; mandibles simple; front, occiput, and cheeks black, but a red band along orbits; scape long, red, with a dusky spot at apex behind; flagellum very long, reddish black, the basal half red beneath; third antennal joint about as long as fourth; mesothorax dusky red, with a broad median black stripe and obscure sublateral ones; white hair patches on mesothorax dense and bright; tegulæ clear red; wings dusky at apex; basal nervure going a short distance basad of transverse median; second submarginal cell large; legs clear ferruginous, only the hind tarsi dusky; abdomen with broad dusky bands; venter clear red.

LEYTE, Tacloban (*Baker* collection).

Nomada concessa sp. nov.

Female.—Length, about 6 millimeters; black, marked with yellow and red; closely related to *N. bakeri,* but differing thus: Mesothorax very distinctly shining between the punctures, its lateral margins reddish; first abdominal segment broader, and with a broad band; hind tibiæ red.

MINDANAO, Dapitan (*Baker* collection).

Nomada bakeri Cockerell.

Nomada bakeri COCKERELL, Ann. & Mag. Nat. Hist. (1915), VIII, 15, 263.

LUZON, Mount Maquiling (*Baker*).

Nomada lusca Smith.

Nomada lusca SMITH, Cat. Hymenop. Insects British Museum, pt. 2 (1854), 243; BINGHAM, Fauna British India, Hymenoptera (1897), 1, 465; COCKERELL, Trans. Amer. Ent. Soc. (1905), 31, 313; COCKERELL, Ann. & Mag. Nat. Hist. (1915), VIII, 15, 263.

LUZON, Los Baños; Benguet, Baguio (*Baker*). This species was briefly described by F. Smith from the Philippine Islands, the particular island not stated. I have examined Smith's type in the British Museum. Bingham recorded the species from "Sikhim; Tenasserim; Ceylon; Philippines;" remarking however that the variety he described appeared to be intermediate between the Philippine *N. lusca* and the Indian *N. adusta.* I have little doubt that true *N. lusca* is confined to the Philippines, the Indian specimens belonging to one or more distinct species. Bingham was inclined to lump species in *Nomada;* thus he placed *N. subpetiolata* Smith as a synonym of *N. adusta* Smith, but Meade-Waldo later reëstablished it as a valid species.

THE OSTEOLOGY OF THE GIANT GALLINULE OF THE PHILIPPINES, PORPHYRIO PULVERULENTUS TEMMINCK

WITH NOTES ON THE OSTEOLOGY OF TACHYBAPTUS PHILIPPENSIS (BONNATERRE) AND HYDROPHASIANUS CHIRURGUS (SCOPOLI)

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FIVE PLATES

Before describing the skeleton of this big paludicoline bird, it will be as well to present a brief history of what we know of its habits, distribution, taxonomy, and other matters of interest. For this history I am indebted to Mr. Richard C. McGregor, ornithologist of the Bureau of Science at Manila, who has kindly furnished me with the following notes:

Porphyrio pulverulentus Temminck.

Porphyrio pulverulentus TEMMINCK, Pl. Col. (1826), 5, Pl. 405; SHARPE, Cat. Bds. Brit. Mus. (1894), 23, 207; Hand-list (1899), 1, 109; MCGREGOR, Man. Phil. Bds. (1909), 81.

Distribution.—Philippine Islands.

At the time that Sharpe wrote volume 23 of the Catalogue of Birds, the British Museum possessed only two specimens of the Philippine blue gallinule; these are listed as follows:

a. Ad. sk.	Manila, Luzon.	Hugh Cuming, Esq. [C.].
b. Juv. sk.	Manila.	Gould Coll.

It is very unlikely that either of these was collected in the vicinity of Manila. That they came from Laguna de Bay is probable, for the species can be found at many points along the shores of that lake, but it is nowhere as abundant as the moorhen (*Gallinula chloropus*).

Since the Catalogue of Birds was written, this gallinule has been collected in Bohol, Mindanao, and Mindoro, as well as in Luzon. It is probable that it occurs on all of the larger islands where there are suitable lakes with shallow reed-filled water near the shores.

The food of *Porphyrio*, as indicated by the stomach contents of specimens collected at Paete, Laguna, Luzon, consists of fresh-water snails, small insects, seeds, and vegetable matter that could not be determined. When startled or surprised this gallinule stands erect, as if at attention. From this and its conspicuous red bill the Spaniards called it "artillero."

The most conspicuous external features of this bird are the heavy bill and long, heavy feet. It has a striking resemblance to the pictures of *Notornis*, next to which the genus is placed in Sharpe's Hand-list. See the text figure of *Notornis* in Knowlton, Birds of the World, page 325, and in Newton, Dictionary of Birds, page 592. You will notice that the

frontal shield in the specimens of *P. pulverulentus* extends much farther backward than is represented by Newton for either *Notornis* or for *Porphyrio*. If you happen to have a copy of Egyptian Birds, by Charles Whymper, London, Adam and Charles Black, 1909, you will find, facing page 168, some nice studies of *Porphyrio madagascariensis* that might pass for the Philippine *Porphyrio* if done in black and white.

In times past, in various journals here and in Europe, I have published complete accounts of the skeletons of all the American Gruidæ, or cranes; a full description of the skeleton of *Aramus vociferans;* and the same of the majority of our Rallidæ, or rails, gallinules, and coots. These papers and monographs are now so well known to ornithotomists and to many ornithologists, that it will not be necessary to cite them by title in the present connection. This also applies to such descriptions as I have published on the osteology of paludicoline birds of the Old World and elsewhere.

At the present writing I have been unable to obtain the skeleton of an American gallinule; so I shall compare the bones of the Philippine giant gallinule with the corresponding ones in the skeleton of a coot (*Fulica americana*). Such material has kindly been loaned me by the Division of Birds of the United States National Museum. (No. 19710, adult male?)

There are but few marked differences to be discovered when we come to compare the skeletons of the soras, the cranes, the short-billed rails, the gallinules, and the coots, or other closely allied forms in the same group. Still there are some interesting points to be noticed along such lines, and they are of generic as well as specific significance. Most of them, it would seem, pertain to the skull rather than to any other part of the skeleton.

OSTEOLOGY OF PORPHYRIO PULVERULENTUS

The skull.—As compared with *Fulica*, there is a general lack of pneumaticity in the entire skeleton of this big gallinule, which is corroborative evidence that the demand for its being a good flier is considerably less; moreover, it points to the fact that its relation to *Notornis* is much nearer than any of its congeners of the allied groups of the Rallidæ. This reduction of the amount of air gaining access to the inner recesses of the bones is well exemplified in the skull, as compared with that part of the skeleton in the coot; consequently we find it to be, in the gallinule, thicker, denser, darker, and proportionately heavier in comparison—a condition which is largely extended to other parts of the skeleton, as will be seen further on in this description.

Viewed upon its superior aspect, the skull of *Porphyrio* will be seen to be very broad in its interorbital area, generally convex, with almost complete reduction of the superorbital glandular fossæ, and, posteriorly, faintly differentiated from the parietal area of the cranium. The craniofacial line is not as strongly marked as it is in *Fulica*, though on both the naso-premaxillary sutures are distinctly in evidence on this superior view of the skull.

When we come to regard the cranium of this gallinule laterally, we find a number of very striking differences, as compared with what obtains in our coot. In the former, the superior mandible is proportionately far more massive, broader, and deeper from above downward. Furthermore, its decurvature is more pronounced, and it is carried more abruptly to a sharper apex. The osseous roof of the mouth is not as open as it is in the coot, while the external narial apertures in this *Porphyrio* are relatively, as well as actually, very much smaller and of an elliptical outline (Plate II, fig. 10).

A lacrymal bone in our subject differs very considerably from that element of the cranium in *Fulica;* for in the first-mentioned bird its superior portion is curved and elongate, making close articulation with the external margins of the frontal and nasal. It is pneumatic, while the foramen is usually in the lower portion. This latter is rather broad, thin, curved, and pointed below; a small, free ossicle brings it in articulation with the infero-external angle of the thin, oblong, though thoroughly ossified pars plana of the same side. In the coot the lacrymal is triangular for its lower portion—triangular and very thin—being produced as a spiculalike point below. It is separated by a wide interval from the pars plana, or ethmoidal wing. The latter is a thin lamina of bone presenting several peculiarities. Its superoexternal angle is produced forward as a slender process in contact with the under surface of the frontal, while internally, immediately below this same surface, an extensive elliptical foramen is formed for the passage of the nerve to the rhinal chamber.

In both the *Porphyrio* and the coot the interorbital septum is almost entirely lacking in bone, which also applies to the anterior cranial wall above and behind it. Both birds have the foramen rotundum circular and complete.

Porphyrio pulverulentus has the zygomatic bar very straight, rather broad, and transversely much compressed, rendering its upper and lower edges sharp.

On the side of the cranium the crotaphyte fossa is well defined (Plate II, fig. 10), which is not the case in *Fulica*.

Both species have a pronounced postfrontal process, which points directly downward in either species; while in *Fulica* the squamosal process is spiculiform. In the Philippine gallinule it is broad and transversely flattened, constituting a conspicuous character of the side of the skull.

These birds have the osseous meatus of the ear very open, which admits, in the dried skull, of a complete view of the interior parts, the nature of the articulation of the head of the quadrate, the Eustachian passage, and other characters. This is also true of the coot; but in that bird the posterior wall of the osseous meatus is not nearly as much thickened, either relatively or actually, as it is in the big gallinule of the Philippines. Posteriorly, in either species, the supra-occipital prominence is conspicuously developed, and is not pierced by twin foramina as it is in many birds. A well-defined occipital ridge is present and very distinctly marked as a bounding line to this region. Above, on either side, the bounding line of the crotaphyte fossa runs into it; the points where the two lines meet it are 13 millimeters apart.

The external surface of the cranial vault is flatter than it is in the coot and presents a pair of parietal eminences placed side by side. Beyond this the frontal region, superiorly, is smooth and convex from before backward, merging gradually with the nasal on either side, but terminating abruptly and mesially in a transverse line over the premaxillaries; the latter are thoroughly united, with all sutural traces absorbed.

A quadrate has a large, inturned, blunt orbital process, with an extensive articulation for the mandible, it being triangular in form, with an articular, convex facet at each angle.

A pterygoid is short and not much twisted upon itself; it is broadened anteriorly, and the two bones meet in the median line, when normally articulated as they are in life.

The palatines are very intimately in contact in the median line, below the rostrum of the sphenoid, as far forward as the union with the bifurcation of the vomer, which latter fuses with them. The hinder part of either palatine below has an inner and an outer crest running forward and parallel with each other. Above, the broad orbital surface, however, is smooth and flat. Beyond this either bone mounds up in a peculiar way to meet the lower part of the ethmoidal wing and lacrymal bone of the same side. Still more anteriorly a palatine fuses with the maxillopalatine; the latter is separated from the fellow

of the opposite side by quite an interval. The vomer is keeled inferiorly; it is slightly spreading above and is pointed at its free anterior apex.

Fulica has all of these bones far more delicately constructed and slenderer. In this species the prepalatines are extremely slender rods, the postpalatine parts being short, and far removed, on either side, from the pars plana. Moreover, a maxillopalatine is a shell-like bone, distinct from its fellow, being attached at the point of union of the zygoma, the nasal, the prepalatine, and the dentary part of the premaxillary. It is elliptical in outline, with its major axis parallel to the slender prepalatine, while its outer surface is concave, and the mesial correspondingly convex.

The external narial openings in the coot are very large and elongate, which is not the case in *Porphyrio* (Plate II, fig. 10).

As in many birds, the mandible is a V-shaped bone, with deep, thin rami and extensive symphysis in this species. There are no postarticular processes present; in fact, the hinder aspects of the articular ends of this mandible are substantially flat surfaces, only slightly concaved and lying in planes perpendicular to the long axis of the bone. The free margins, both above and below, are moderately rounded, while the dentary ones above are cultrate, terminating in a subacute apex anteriorly.

There are two foramina in either ramal part; that is, the usual splenial one, which is elliptical in outline, and another, smaller one, posterior to it, halfway between the first and the articular extremity, which is circular in outline.

Posteriorly, the ramal portion of the bone is thin, it being considerably heavier for its anterior portion. Most of the former moiety exhibits some pneumaticity, and this condition is present in a good part of the cranium and associated bones of the palatal region and face; it is also true of the ossa quadrata.

The ear bones have been lost.

In *Fulica* we also find a V-shaped mandible, with a number of its general characters agreeing with the corresponding ones in *Porphyrio*. The former, however, has the bone more elongate, narrower, and with a shorter symphysis. Finally, its ramal sides are not nearly so deep nor so thin. Then, too, in *Fulica* there is a special character not found in *Porphyrio*, which is well worthy of notice. It consists of little semicircular plates of bone attached, one on either side, just above the splenial foramen on the superointernal margin of the ramus. These platelets are directed horizontally and toward the median line. My impression is that each is covered with the horny theca of the

lower jaw and is capable, in life, of being moved up and down in the vertical direction. They are not present in *Porphyrio;* and what their special function is in life is difficult to conjecture. (Specimen No. 19710, collection United States National Museum bird skeletons.)

The hyoid bones (Plate I, fig. 4) are extremely slender and elongate, and the glossohyal remains in cartilage throughout life, while the very minute urohyal is prolonged by a short, threadlike extension. This part of the skeleton of the coot at hand has been lost, so no comparisons can be made. It is fair to presume, however, that the skeletal parts of the tongue in these two birds are very similar.

The trunk skeleton.—There are thirteen vertebræ in the cervical division of the spinal column of *Porphyrio* wherein the pleurapophyses are not free; in the fourteenth they are small, and are found to articulate freely with the vertebra, while in the fifteenth each rib of the pair is long and as slender as a needle. They do not reach the sternum, nor are epipleural appendages present upon them. The fourteenth vertebra has some of the characters of a leading dorsal, and these are still more pronounced in the fifteenth vertebra (Plate III, fig. 11).

The cervical vertebræ in *Fulica* are far more delicately fashioned than they are in the big gallinule of the Philippines. Proportionately, they are more elongate, with the pleurapophyses of the fourth to the eighth, inclusive, needlelike and long; in *Porphyrio,* relatively as well as actually, they are shorter and blunter. Only the second, third, and fourth have low, blunt, neural spines upon them, while in the fourteenth and fifteenth these processes are conspicuous and resemble the dorsal neural spines, only they are not so broad anteroposteriorly. Hæmapophyses are present on the atlas and on the next two vertebræ behind it; they then disappear, to be seen again on the eleventh, twelfth, thirteenth, and fourteenth, where they are thin laminæ of bone in the median line and transversely compressed.

The carotid canal is open for its entire length; while the vertebral canal, on either side, is completely surrounded by bone in the third to thirteenth cervicals, inclusive.

In both *Porphyrio* and *Fulica* the first two dorsal vertebræ possess hæmal spines resembling those of the cervical vertebræ; they are short and transversely compressed. On the other hand, all of the vertebræ in this division of the spinal column possess very large, thin, quadrilateral neural spines, which increase in size from first to last as we proceed in the anteroposterior direction. Their free superior margins are slightly thickened; and

from the second to the eighth dorsal vertebra—the latter the last of the series—they are in contact at all of their superior angles, each vertebra with the one next behind it. The anterior and posterior margins of these neural spines are concave in outline and sharp. This, in the articulated skeleton, leaves elliptical vacuities among them (Plate III, fig. 11). There are linking metapophyses on the superior outer extremities of the transverse processes of all these dorsal vertebræ; while in *Fulica* the neural spines above are lashed together through the ossification of the tendons of the muscles of the back.

As will be noted from Plate III, fig. 11, of the present article, the dorsal ribs of *Porphyrio* are long and slender, as in the case of all true coots and gallinules, with costal ribs, or hæmapophyses, to correspond with them. The leading five support epipleural appendages—six in *Fulica*. There is always a pair of slender pelvic ribs; but the costal ribs of this pair do not articulate with the sternum.[1]

The pelvis.—Porphyrio has a pelvis that is shorter and broader than it is in *Fulica* and in the gallinules—relatively with respect to the latter and actually with respect to the former. This increased breadth is especially marked in the postacetabular portion of the bone; it is also of denser and heavier build in the big gallinule of the Philippines than in the other forms mentioned.

The preacetabular portion is elongate, narrower, and markedly concaved on the external iliac surfaces, which in *Porphyrio* fuse with the superior margin of the presacral vertebræ for its full length, completely closing up the iliac-neural posteriorly. Curiously enough, in the coots and gallinules the inner margin of the middle third of the preacetabular part of either ilium is concave and sharp, thus sweeping below the superior margin of the sacral crista, between the anterior third of the crest and the posterior, which latter is opposite the acetabulæ. At this interval the inner margins of the ilia are not in contact with

[1] When the present paper had been finished up to this point, there came to hand a "complete" disarticulated skeleton of a *Gallinula* (No. 18889, United States National Museum). It is from an adult individual collected by Dr. W. L. Abbott on Ile St. Louis, of the Seychelles. The skull, hyoid arches, vertebræ, and ribs in this species of gallinule resemble those parts of the skeleton in *Fulica* more than they resemble the corresponding bones in the skeleton of *Porphyrio*. It is to be noted, however, that the curious processes on the mandible found in *Fulica* are not present in this *Gallinula;* while the cranium, on the other hand, agrees in all respects with that of *Fulica,* and consequently exhibits the same differences when we come to compare it with the cranium of *Porphyrio*.

the sacral crest, a little open slit being present as a consequence; this is also the arrangement in *Gallinula*. In most respects, the postacetabular portion of the pelvis in this *Gallinula* agrees in its characters with the corresponding ones as we find them in *Porphyrio*. There are two striking characters, however, which agree, upon comparison, in *Fulica* and *Gallinula* and depart from the corresponding ones in *Porphyrio;* they are these: The posterior-inferior angle of the ischium in the coot and in the gallinule is drawn downward and outward as a conspicuous process; this angle is truncate in *Porphyrio*. Again, the distal free extremity of the postpubic rod in *Fulica* and in *Gallinula* is bent downward at an angle with the rest of this rod, the bending taking place at a point opposite the posterior-inferior angle of the ischium of the same side. Turning to the skeleton of *Porphyrio,* we note that this angle of the ischium on either side is truncated, and that the postpubic rod is not bent at any part of its length (Plate III, fig. 11).

In all the species of this coot-gallinule group of birds there is a very remarkable character on the inferior side, or ventral aspect, of the hinder part of the pelvis; it consists of a deep, pocketlike recess, or concavity, apparently formed by the extension, on either side, of the ischium. Mesiad, it thoroughly coössifies with the last three vertebræ of the pelvic sacrum, and its anterior free margin beneath is sharp and concave in outline. The completed osseous pockets thus formed are deep and capacious, occupying very nearly one-half of the postacetabular concavity of the pelvic basin. Each extends as far forward as the posterior margin of the rather large subcircular ischiadic foramen on either side.

There are seven small free caudal vertebræ in *Porphyrio* to eight in *Fulica*. In addition to these in each bird there is a more or less inconspicuous quadrilateral pygostyle. When duly articulated, these vertebræ form an arc, which is concave along its superior line (Plate III, fig. 11).

The shoulder girdle and sternum.—There is a great similarity in the characters with respect to all the bones of this part of the skeleton in the bird forms referred to in the present paper.

In *Porphyrio* a scapula, in the articulated skeleton, reaches almost as far back as the pelvis; it is narrow, flat, pointed, and markedly curved, being convex along its inner border and correspondingly concave along its outer one. In *Fulica* this is much narrower, longer, and less curved and does not seem to articulate with the os furcula, whereas it does so, extensively, in *Porphyrio*.

A coracoid in our present subject is a stout, straight bone, much expanded for its sternal moiety, which part is concave posteriorly and nearly flat anteriorly. As in *Fulica* and *Gallinula* it develops a sharp process at the outer inferior angle of its shaft, and the two bones in none of these genera meet in the coracoidal groove of the sternum in the articulated skeleton. All three bones of the arch assist in forming, superiorly, the "tendinal foramen." The very delicately formed "fourchette" is a U-shaped bone in all of these paludicoline birds (Plate III, fig. 11), and lacks anything like a hypocleidium. At the median point of the arch below, however, there is usually developed a minute process on the upper side, directed upward.

None of the bones of the pectoral arch in any of these genera is pneumatic, which is also true of the sternum; in fact there is little or no pneumaticity of any part of the skeleton, as we find it among the various genera of the marsh birds. Indeed, this is what we would expect in the case of fowls that make so little use of such powers of flight as they possess.

There is no mistaking the sternum of any species of this interesting group, and the characters of the bone are much the same throughout. The anterior border of the keel in *Porphyrio* slopes away posteriorly, more than it does in *Gallinula* and the coots; but beyond this the differences are barely of generic rank (Plate III, fig. 11).

The sternal body is narrow and much concaved on its dorsal aspect. Markedly prominent, the quadrilateral "costal processes" are flaring and truncated superiorly. A very small manubrium is present, and the costal grooves are practically continuous with a median notch above them on the superior border.

The "carina" is well developed, being concave on its anterior border and convex on its inferior, the "carinal angle" being acute. There are six articular facets upon either costal border in *Porphyrio* and *Fulica,* but apparently only four or five in the *Gallinula* from the Seychelles Islands.

The midxiphoidal process, with the carina running the entire length of it on its ventral aspect, is bluntly pointed posteriorly, and an isosceles triangle in outline, the somewhat blunt angle being acute.

This xiphoidal portion of the bone is profoundly one-notched upon either side; the notch being triangular, with the angle pointing anteriorly. This gives rise to a long, lateral xiphoidal process on either side; each process is narrow, of uniform width, and somewhat expanded at its free extremity. Plate II, fig. 7, gives some idea of the ossifications that take place in

trachea; they are quite ordinary, which is likewise true of such ossifications as are met with in the larynx.

The pectoral limb.—All the bones of either limb in *Porphyrio* are entirely nonpneumatic, and this is apparently the case in *Fulica, Gallinula,* and their near congeners in various parts of the world. In *Gallinula,* when the skeleton is carefully cleaned and bleached, the humeri—as is the case in all the bones—are extremely light and creamy white; but they present no pneumatic foramina at the sites where, when present, they occur in the vast majority of birds. All the bones of the limbs in *Porphyrio,* even when carefully prepared, are dark and greasy—at least this is the case with those before me, and they were prepared at the United States National Museum.[2]

In their morphology the pectoral limb bones in *Porphyrio* and *Fulica americana* are wonderfully similar, the several bones being somewhat shorter and correspondingly slenderer in the latter species. The humeral shaft in the coot is a shade stouter. In *Porphyrio* the bone has an extreme length of 7.8 centimeters; in *Fulica,* 7.5 centimeters. Were these two bones found fossil, they would never be described by any competent avian palæontologist as having belonged to representatives of different genera. In the humerus of the coot the pneumatic fossa is deeper and somewhat more circumscribed; and this, apart from the difference in length, is the only distinguishing character of any consequence.

The form of the humerus in *Porphyrio* is well shown in Plate I, figs. 1 and 6. It will be noted that the radial crest is very low (fig. 6); and the notch, or valley, between the humeral head and the thickened proximal portion of the ulnar crest overarching the pneumatic fossa is notably deep and characteristically conspicuous.

Radius is nearly straight and inclined to be slender, while the ulna exhibits considerable curvature, thus insuring, in the articulated skeleton, a rather broad "interosseous space."

Radiale and ulnara of the carpus present the usual ornithic characters and articulations. The shafts of the carpometacarpus are long and slender (fig. 1), and the pollex phalanx supports a free claw at its distal end; but no such claw occurs on the terminal phalanx of the index digit.

The general characters of the pelvic limb may be well seen in Plate II, fig. 8.

[2] I am inclined to believe that Mr. Scollick made no attempt to degrease or bleach this skeleton.

The head of the femur is very small in proportion to the size of the remainder of the bone; and the pit for the ligamentum teres is extensive and rather deep. Rising somewhat above the summit of the bone, the trochanter major is very broad across its outer aspect. While bowed to the front, the shaft of the bone has a curious though very slight turn in it about its middle (fig. 8). Distally, the condyles are large, and the fibular notch in the outer one is notably deep. As a matter of fact, the skeleton of the pelvic limb of *Porphyrio* is not only big-boned for the size of the bird; but the individual bones are long, with conspicuous characters at their extremities. No patella is to be seen in this limb, and this is also true of the coots and gallinules.

Porphyrio has a very long tibiotarsus as well as tarsometatarsus, and this is also true of the joints of pes (Plate II, fig. 8). In the first-named segment of the skeleton of the leg, the cnemial process is rather conspicuously developed, it being confined to the upper part of the shaft. The "ectocnemial projection" terminates in a little hook at its lower angle. *Fulica* has the entocnemial process wonderfully developed; it not only rises well above the summit of the shaft of the bone, but also projects far forward and to some extent downward. Often the fascia attached to its inferior border ossifies to some considerable extent, especially the outer margin of it, running into the antero-inner surface of the shaft at a point below the "fibular ridge" on the other side. The "ridge" referred to is well developed in all of these paludicoline birds, distinctly so in *Porphyrio*, while in it, as in all of them, the fibula is very weak, and partly ligamentous below its articulation with this projection. At the distal end of the tibiotarsus, on the anterior aspect, we may note above the condyles the usual ossified tendinal bridge crossing the longitudinal groove in that locality.

Taking the unusual development of the proximal extremity of this bone into consideration, it is worthy of note that the condylar end is, relatively speaking, not so markedly enlarged; that is, the condyles, though of good size, are not strikingly bulky. As is usually the case, the outer one is the larger and the rounder in outline, and, anteriorly, the thicker in its transverse diameter. To some extent they project beyond the surface of the shaft, posteriorly, thus continuing the intercondylar valley in that locality.

Hypotarsus of the tarsometatarsus is well developed, but in *Porphyrio* appears to be neither grooved nor pierced for the passage of tendons. It is both once-grooved and once-pierced

in *Fulica* and in *Gallinula*, though feebly so in either case. *Porphyrio* has simply a shallow, central depression there to guide the passage of the tendons of the muscles coming down from the leg.

Our big gallinule has the shaft of the long tarsometatarsus somewhat flattened on its anterior and posterior aspects, and these surfaces are strongly grooved for their entire lengths, particularly on the hinder aspect, where the tendinal gutter runs the entire length of the straight shaft of this element of the pelvic limb.

A large accessory metatarsal is present, being hinged to the shaft by strong ligament at its usual site in ordinary birds; it supports the big phalanx and claw of hallux. All the other phalangeal joints of the three anterior toes of pes are lengthy and of considerable caliber, as will be seen by referring to Plate II, fig. 8.

This brief review of the osteology of *Porphyrio* shows it to be a form possessing many of the characters of the typical paludicoline fowls; at the same time it exhibits not a few others that are distinctly generic in kind, especially those that have been described above as pertaining to the skull and to the pelvis.

NOTES ON THE OSTEOLOGY OF TACHYBAPTUS PHILIPPENSIS (BONNATERRE)

Early in August, 1917, when Mr. McGregor sent me the skeletons of *Porphyrio pulverulentus*, he also sent for my examination rough skeletons of *Tachybaptus philippensis* (Bonnaterre) and *Hydrophasianus chirurgus* (Scopoli); one each of these two species has been cleaned for me by Mr. Scollick, of the United States National Museum, an assistance for which I have to thank Dr. James E. Benedict, chief of exhibits of that institution. When Mr. McGregor sent me these skeletons, he also included brief life histories of *Tachybaptus* and *Hydrophasianus*, which I may some day use in another connection; the present brief notes refer, as their title indicates, simply to their osteology.

The specimen of *Tachybaptus philippensis*, an adult male from Paete, Laguna, Luzon, P. I.; March 26, 1917 (*McGregor*), is No. 226033, United States National Museum. The entire skeleton of this bird presents the characters of those found in that part of the anatomy of any small average grebe. Indeed, they are quite typical, as I find to be the case upon comparing the various bones with the corresponding ones in the skeleton of *Podilymbus podiceps* (No. 17272, United States National

Museum) and those of *Colymbus cornutus* (No. 17873, United States National Museum).

Taken as a whole, the skull of *Tachybaptus* agrees much better with the skull of *Colymbus* than it does with that of *Podilymbus*—a fact due principally to the shortening and broadening of the superior mandible and jaw in the latter form. The space between the superior peripheries of the orbits in the frontal region is quite as broad in the Philippine grebe as in the dabchick, while in the horned grebe it is much narrower.

Tachybaptus presents a peculiar character in the pterygoids not to be found in the skulls of the two species with which it is here being compared; this consists in their being, in the case of either pterygoid, gradually broadened out by thin laminæ that pass from the quadrate end to the palatine of the same side, the broadest part being the distal third. In *Colymbus* these bones are very slender rods, with scarcely a trace of laminar expansion.

The hyoid arches seem to have been lost in these skeletons except in *Tachybaptus*, where they have been preserved with the trachea. The glossohyal is rather short and broad, the urohyal being very slender. The hypobranchials are long, and the ceratobranchials very short, while the two together are reduced almost to hairlike proportions, so exceedingly slender are they in caliber.

Throughout its length the trachea is simple in structure, and the numerous rings are entire and thoroughly ossified from first to last.

The true grebes seem to possess eighteen cervical vertebræ in the spinal column to seventeen of *Podilymbus;* possibly one may have been lost in the skeleton of the latter bird at hand, but I am inclined to think not.

Tachybaptus has the first pair of ribs on the nineteenth vertebra; they are without costal ribs, though the epipleural appendages are well developed and long. These do not ankylose with their ribs anywhere in the series, and they are found upon the next following four pairs of ribs, all of which latter have true costal ribs. There are two pairs of pelvic ribs; the first pair reaches the sternum through costal ribs, while the second does not. Behind these a very delicate pair of floating hæmapophyses is seen. None of these possess unciform appendages.

We find the same arrangement in *Podilymbus podiceps,* while in *Colymbus cornutus* there are nine pairs of ribs, the leading seven pairs having unciform processes. The first two pairs do not possess costal ribs; and the last two pairs, which are pelvic

ribs, are without appendages. Only the first pair of these pelvic ribs has costal ribs, while an aborted floating hæmapophysis, long and slender, completes the series.

Morphologically, the grebe's pelvis is well known—comparatively speaking as well as actually; it is shorter in *Tachybaptus* than in either *Colymbus* or *Podilymbus;* in the latter genus it is extremely long and strikingly narrow. Nothing of particular note marks the small caudal vertebræ in this little grebe of the Philippines.

In regard to its shoulder girdle, or pectoral arch, it comes nearer *Podilymbus* than it does to *Colymbus,* especially in the matter of the U-shaped furcula; for there is no hypocleidium present except in the case of *Colymbus cornutus,* where it is a well-developed peg of bone directed backward.

The sternum presents all the usual characters as we find them in the grebes generally; it is nonpneumatic, and the mid-xiphoidal notch is notably shallower than in the dabchick and most other American grebes. This is also true of the lateral sternal notches, while the lateral xiphoidal processes are stouter and shorter than we find them among the birds last mentioned.

As among the Colymbidæ generally, the long bones of the arm and hand in *Tachybaptus* are completely nonpneumatic, while in form they are long and slender. While the usual "sigmoid curve" is to be seen in the humerus, it is not nearly as well marked as we find it in many other groups of birds. Then, too, the general characters of the proximal extremity of the bone are more or less feebly developed—a fact that causes no surprise, in as much as these birds are feeble fliers as compared with many other aquatic species. There are no claws on the phalangeal joints, and the carpometacarpus is long and slender.

Judging from appearances in the prepared skeleton, it would seem that the femur and the superior halves of the bones of the leg might be to some extent pneumatic, which is not the case in the grebes found in North America. Otherwise, the morphology of this part of the skeleton in *Tachybaptus* is entirely in agreement with that of any small grebe; this especially applies to the patella and other features of the knee joint. As in other grebes the inner trochlea of the tarsometatarsus is situated posteriorly on the shaft of the bone, and the accessory metatarsal, with its joint and claw (hallux), is found well up the shaft above it. The ungual joint of the midanterior toe is much expanded and shell-like, while in the case of those of the other

two toes, though thin and flattened, they are no wider than the joint next behind them in the case of either toe; this is also characteristic of the American grebes.

NOTE ON THE SKELETON OF HYDROPHASIANUS CHIRURGUS (SCOPOLI)

Hydrophasianus possesses no special osteological characters not found in any typical jacana; as, for example, in *Jacana spinosa* (Linnæus), the Mexican jacana. This is what we would look for, in as much as it is but a good average representative of the Jacanidæ of the world's avifauna.

Its skull is to some considerable extent pneumatic, including the mandible, while no other part of the skeleton enjoys that condition. There is an unusual resemblance in its skull to some of the sandpipers, and, to a slighter degree, this is likewise to be observed in the remainder of the skeleton; though this does not apply, to be sure, to the greatly lengthened digits of pes.

The sternum is somewhat narrow and elongate, being profoundly once-notched on either side, which gives rise to long, slender xiphoidal processes, and a rather broadish midxiphoidal part with slightly projecting outer angles.

As the skeleton of this species has probably not been heretofore figured—and certainly not from a photograph made direct from the dried skeleton—I am here giving such a plate, which I personally prepared from the skeleton forwarded me by Mr. Richard C. McGregor, and which now forms a part of the collection of bird skeletons in the United States National Museum.

ILLUSTRATIONS

[All of the figures of the plates are of natural size and are reproduced from the author's photographs made direct from the specimens.]

PLATE I

FIG. 1. Left pectoral limb of *Porphyrio pulverulentus* Temminck, seen upon palmar aspect. The bones figured on Plates I to III illustrating this paper are all from the same individual. Adult male, No. 226035, collection of the United States National Museum. Paete, Laguna, Luzon, P. I.

2. The mandible of *Porphyrio pulverulentus*, dorsal view.

3. The skull of *Porphyrio pulverulentus*, superior aspect. See Plate II, fig. 10.

4. The hyoid arches seen from above; the cartilaginous parts of the glossohyal have been allowed to remain by the osteologist who prepared the skeleton at the United States National Museum.

5. The first eight cervical vertebræ of *Porphyrio pulverulentus*, normally articulated and seen from above.

6. The right humerus seen upon anconal aspect.

PLATE II

Fig. 7. Right lateral view of the trachea of *Porphyrio pulverulentus*, with the bronchial extremity and a few rings above it removed.

8. Left pelvic limb of *Porphyrio pulverulentus* seen upon outer aspect. The patella does not exist in this species, its place being taken by a strong fibrous ligament.

9. The leading eight cervical vertebræ of *Porphyrio pulverulentus* seen from below; they are normally articulated as in life, and the upper view of them is shown in Plate I, fig. 5.

10. Right lateral view of the skull of *Porphyrio pulverulentus*, with mandible dissociated. See Plate I, figs. 2 and 3.

PLATE III

Left lateral view of the trunk skeleton of *Porphyrio pulverulentus*, with all its bones normally articulated. This gives a side view of the remainder of the cervical vertebræ, the anterior ones being shown in Plate I, fig. 5, and Plate II, fig. 9.

PLATE IV

FIG. 1. Right lateral view of the skull of *Hydrophasianus chirurgus* (Scopoli); adult female, natural size. Mandible detached. Paete, Laguna, Luzon, P. I. Collection of the United States National Museum.

2. Hyoid arches of the specimen shown in fig. 1.

3. Trachea of the specimen shown in fig. 1.

4. Right pectoral limb of the same individual, seen upon palmar aspect.

5. Right lateral view of the trunk skeleton of the same specimen as in the other figures.

PLATE V

Outer aspect of the skeleton of the left pelvic limb of *Hydrophasianus chirurgus*. From the same specimen as shown in Plate IV. The patella is extremely small and is here shown in its tendon, occupying the extreme upper apex.

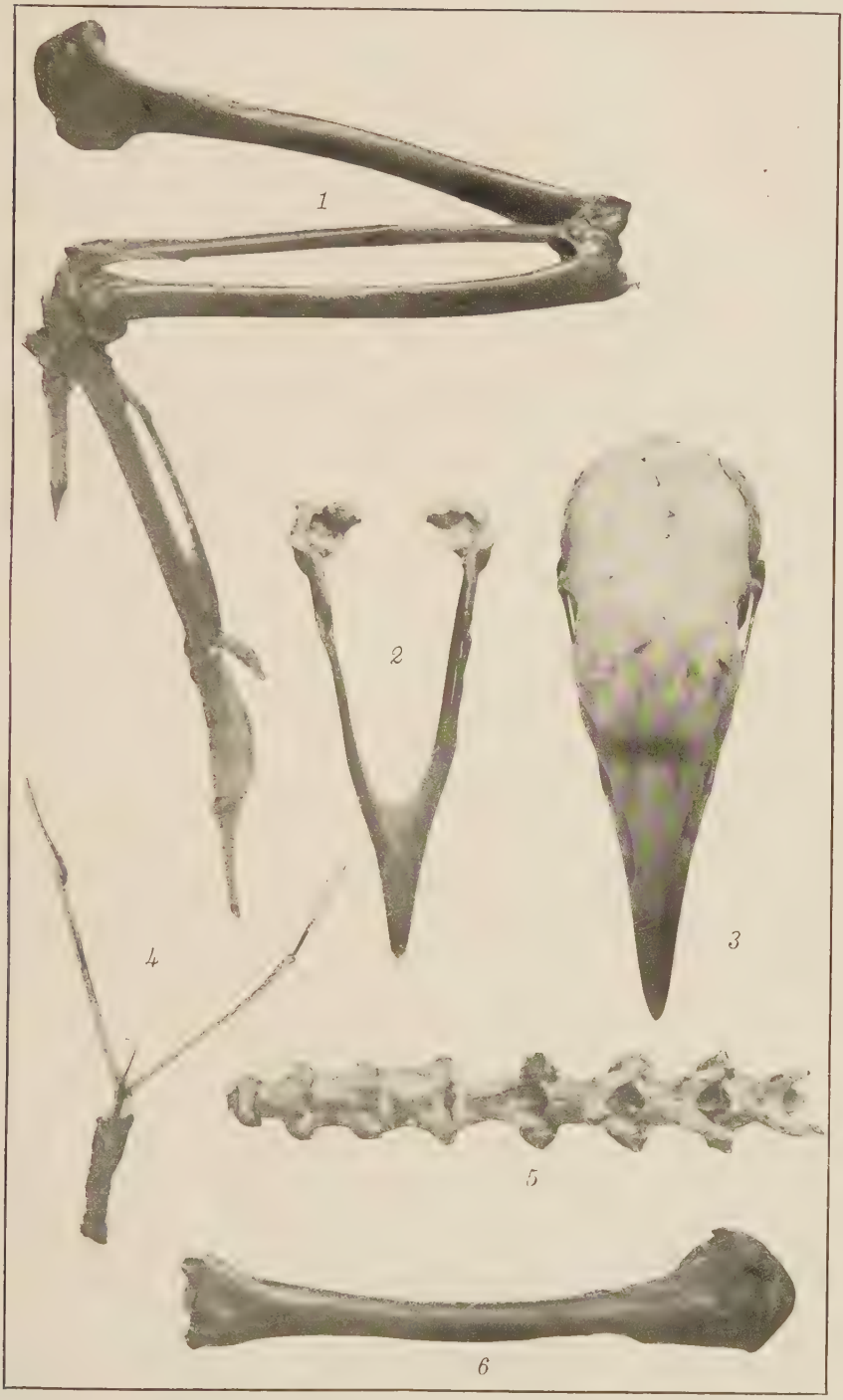

PLATE I. PORPHYRIO PULVERULENTUS TEMMINCK.

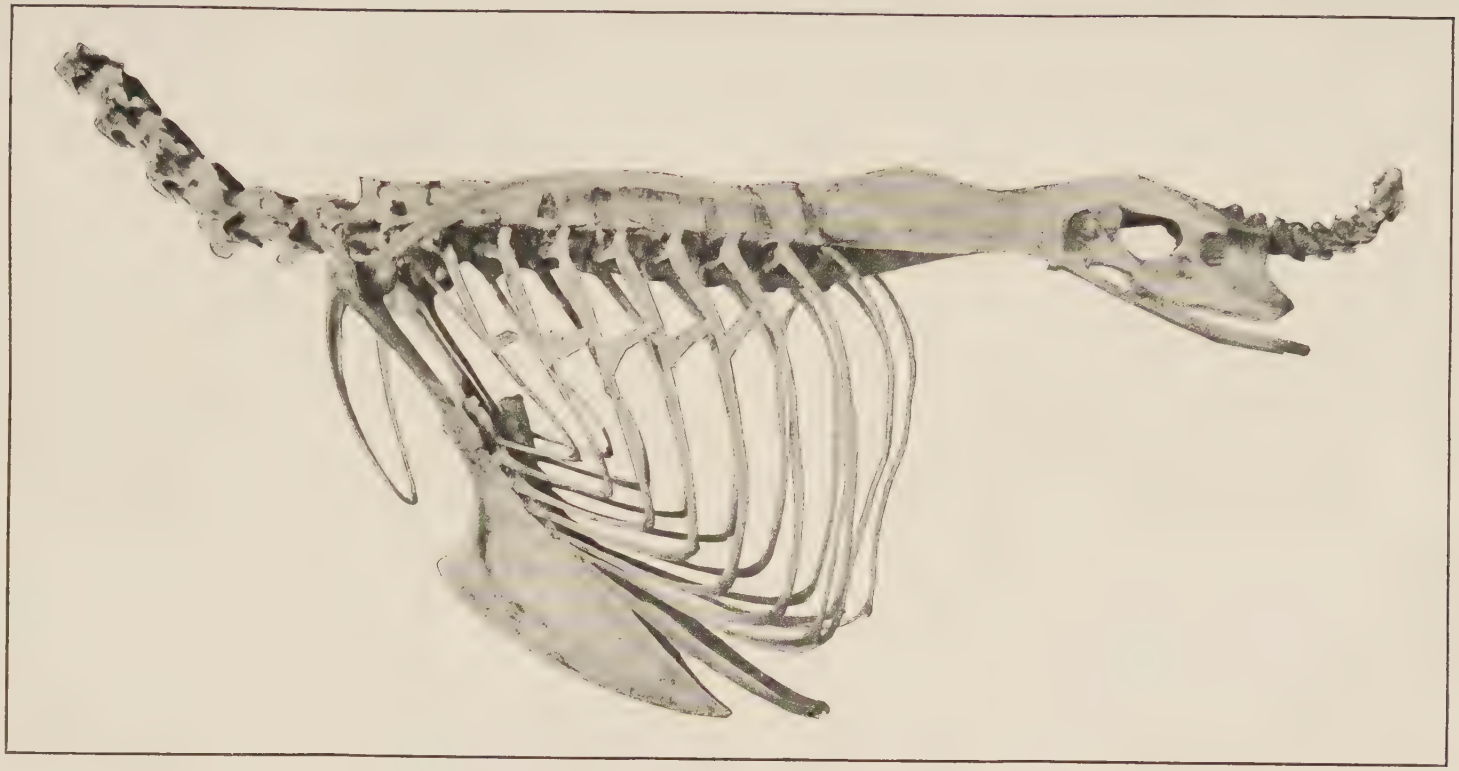

PLATE III. PORPHYRIO PULVERULENTUS TEMMINCK.

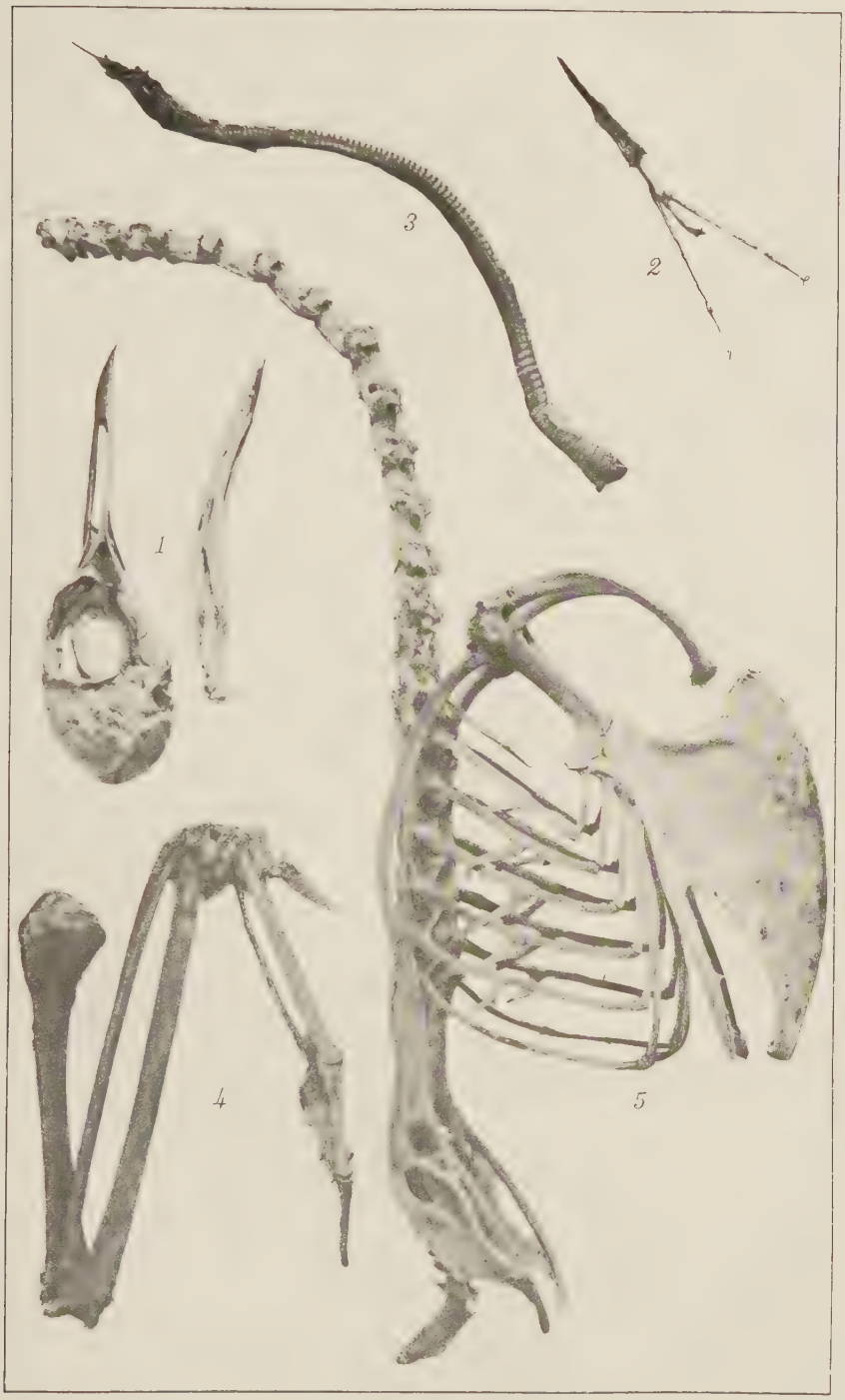

PLATE IV. HYDROPHASIANUS CHIRURGUS (SCOPOLI).

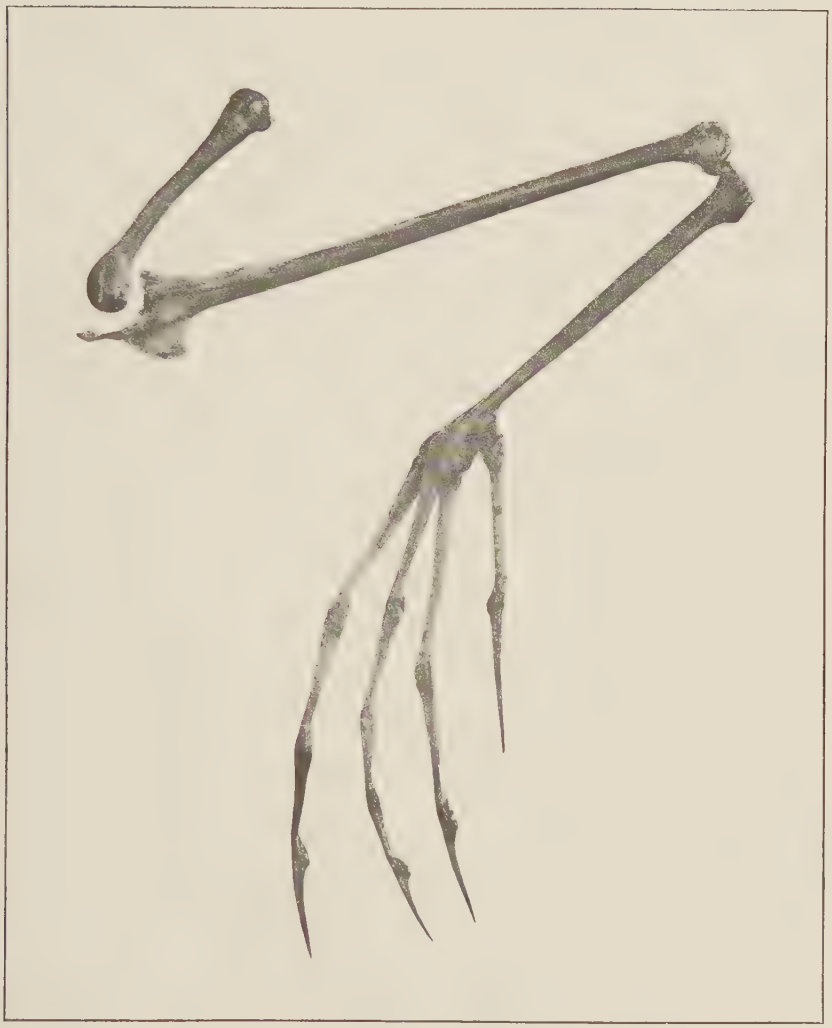

PLATE V. HYDROPHASIANUS CHIRURGUS (SCOPOLI).

NEW OR RARE PHILIPPINE REPTILES

By Edward H. Taylor

(From the Section of Ichthyology, Biological Laboratory, Bureau of Science, Manila)

TWO PLATES AND FOUR TEXT FIGURES

In this paper I am describing five new species of snakes and five new lizards from the Philippine Islands. One species is founded on specimens in the Bureau of Science collections, two on specimens in the Santo Tomas Museum of Manila, and the remainder on specimens in my own collections.

The species described and their respective type localities are as follows:

SNAKES

Typhlops luzonensis. Mount Maquiling, Laguna, Luzon.
Typhlops manilæ. "Philippines."
Typhlops longicauda. Bunawan, Agusan, Mindanao.
Typhlops rugosa. Bunawan, Agusan, Mindanao.
Trimeresurus mcgregori. Batan Island, Batan Islands.

LIZARDS

Lepidodactylus naujanensis. Naujan Lake, Mindoro.
Gekko mindorensis. Pocanil, Mindoro.
Siaphos kempi. Naujan Lake, Mindoro.
Sphenomorphus lednickyi. Aroroy, Masbate.
Sphenomorphus llanosi. "Philippines."

SNAKES

Typhlops luzonensis sp. nov.

Type.—No. 109, E. H. Taylor collection; collected on Mount Maquiling, Laguna, Luzon, May 12, 1915, by E. H. Taylor.

Description of type.—Head rather flat, broader than neck, the lower jaw not or scarcely visible in lateral profile; snout rounded, projecting, rather truncate, the end only slightly less deep than head on a level with eyes; portion of rostral visible above much longer and a little wider than the part below, failing to reach the level of the eyes by a minute distance, and minutely less than one-half the width of head; prefrontal forming a suture with rostral little less than one-third its width, larger than frontal, its longest sutures with the supraoculars; frontal, the smallest upper head scale, forming equal sutures with inter-

parietal and prefrontal; supraocular about the same size as parietal, its lower point barely reaching eye; parietals somewhat narrowed on their lower end; nasal completely divided; nasal suture arises from second labial and after passing nostril reaches rostral in a line horizontal to upper edge of nostril; nasals not in contact behind rostral; preocular reaching above level of eyes, about as broad as ocular, in contact with two labials below; its edge crosses over middle of eye; two postoculars only slightly differentiated from body scales; first labial very small, in contact with anterior nasal only; second labial nearly three time as large as first, touching both nasals and preocular; third labial more than twice as large as second, and a little larger than fourth; lower jaw narrow, about five scales on lower jaw between fourth upper labials; eye a visible black spot, very small, with no pupil evident; about 338 scales from head to vent, 10 subcaudally; tail ending in a small spine.

Color in life.—Above reddish olive brown; below yellowish brown. Each scale with a darker yellowish brown area, giving body a checkered appearance on close examination; rostral, nasal, and labials on underside of snout yellowish white.

Measurements of Typhlops luzonensis sp. nov.

Total length (mm.)	260
Tail (mm.)	4
Width of body (mm.)	4.5
Width of head (mm.)	4.5
Width of tail (mm.)	4
Width of body in total length (times)	58
Width of tail in tail length (times)	1

Remarks.—Only the type specimen is known. The species is obviously related to the group of the genus represented by *T. ruficauda, T. ruber,* and *T. kraalii,* the first two of which are members of the Philippine fauna. From *T. ruficauda* it differs in having four less rows of scales about the body. From *T. ruber* it differs in having the preocular in contact with two labials, the nasal completely divided, and the length greater in proportion to the width of body. (Here the width of body is contained in the total length 58 times, while in *T. ruber,* it is contained 36 times.) From *T. kraalii* it differs in having the rostral much more than one-third the width of the head, and the preocular in contact with two labials; the color is also somewhat different.

Typhlops manilæ sp. nov.

Type.—Specimen in Santo Tomas Museum, unnumbered; labeled "Filipinas;" locality and collector unknown.

Description of type.—Snout rounded in front, projecting; a distinct depression crossing head in region of eyes. Rostral narrowed at a point on snout between nostrils, distinctly longer than wide below; rostral little more than one-third the width of head; nasals not in contact behind rostral; rostral reaching level of eyes; prefrontal rather large, narrowly in contact with frontal; supraoculars large, their lower end not touching eye; frontal slightly smaller than prefrontal, about the same shape; parietals rounding, a little broader than deep, smaller than the supraoculars; interparietal enlarged; nasal not completely divided; the suture issues from the second labial, then makes a backward deflection, widening the anterior part of nasal; preocular narrowed above, reaching above level of eye, but scarcely reaching below level of nostril, abruptly widened below eye, its posterior suture not crossing eye; nasal is much wider than either preocular or ocular; a small subocular scale in contact with second and third labials; preocular touches second labial behind this intercalated scale; ocular widens abruptly on a level with eye; it extends higher than preocular; first labial elongate; second higher and shorter, of nearly the same bulk; third very large, three or four times as large as second, reaching to near the top level of nostril, larger and higher than fourth labial (third labial on one side is fused with subocular); three scales border ocular behind; eyes very small but distinct; nostril comparatively large; lower jaw very narrow, in its middle scarcely two-fifths the width of head. Tail ends in a blunt spine; twelve scales under tail in longitudinal line; snout projecting 2 millimeters.

Color in alcohol.—Reddish brown, darker on posterior two-thirds of body; anterior part rather grayish brown. Head distinctly marked with darker and lighter areas; snout yellowish. Below lighter yellowish, each scale with a slightly darker area.

Measurements of Typhlops manilæ sp. nov.

Total length (mm.)	280
Tail (mm.)	5
Width of tail (mm.)	5.2
Width of body (mm.)	5
Width of head (mm.)	5.5
Scale rows	28

Remarks.—This unique specimen was found in the collection of the Santo Tomas University, Manila. The container was labeled "Filipinas" with no indication as to the locality from which it came. This species has no close affinities among other species of the genus in the Philippines as characterized by the

presence of a subocular. It belongs to the division of the genus of which *T. ater* and *T. inornatus* are members, but differs from all in the very much larger number of scale rows.

Typhlops longicauda sp. nov. Plate I, fig. 1.

Type.—No. R 99, E. H. Taylor collection; collected at Bunawan, Agusan, Mindanao, July 15, 1913, by E. H. Taylor.

Description of type.—Head rather broader than neck, broadly oval in outline; snout with a sharp horizontal cutting edge, moderately projecting, not or but scarcely hooked in profile; rostral not as wide below as above, somewhat narrowed between nostrils, and failing to reach level of eye by more than one-half the depth of prefrontal; the latter wider than deep, larger than frontal, the suture formed with it larger than that with rostral which is only about one-fifth its width; frontal about as wide as deep, equal to the parietals which are about the size of the body scales and scarcely differentiated from them; interparietal somewhat larger than frontal; the supraocular diagonal, the lower point reaching the anterior level of eye, but failing to reach the horizontal level by a distance equal to its distance from nasal; two nasals, the anterior very small, the suture dividing them arises from first interlabial suture; preocular narrower and much shorter than ocular, in contact with two labials below; ocular large, with a slight, rounded prominence over eye; eye and pupil distinct; four postoculars between parietal and fourth labial; four labials, first and second smallest, subequal in size; third more than twice as large as second and about one-half of fourth; scales in 26 rows; about 430 scales in a longitudinal line to above vent; 40 scales in a row on underside of tail.

Color in life.—Above light yellowish brown, gradually becoming lighter below. Head lighter; laterally a distinct, broadly rectangular, lighter spot, including the eye and reaching the mouth. Each ventral scale has a regular darker brown area.

Measurements of Typhlops longicauda sp. nov.

Total length (mm.)	340
Tail (mm.)	34.5
Width of head (mm.)	5.5
Width of body (mm.)	6
Width of tail (mm.)	4.75
Body width in length (times)	56.6
Tail width in tail length (times)	7.2

Remarks.—This species has a very marked, apparently normal, enlargement of the pelvic region, which suggests a greater de-

velopment of the pelvic bones or the rudimentary leg bones. The tail in this species is believed to be comparatively longer than in any other of the extremely numerous species of this genus.

The type specimen was obtained from the trunk of a small tree, which was bored full of tunnels by large black ants. It probably feeds on the larvæ of ants. There are eleven specimens in my collection.

Typhlops rugosa sp. nov.

Type.—No. R 97, E. H. Taylor collection; collected at Bunawan, Agusan, Mindanao, July 14, 1913, by E. H. Taylor.

Description of type.—Head rough, the anterior outline broken by depressions between scales along the sutures. Rostral a little longer than wide above, not reaching to level of eyes, more than one-third the width of head; below the enlarged part about as deep as wide, forming a slightly curved hook on snout; rostral dimly granular; prefrontal a little wider and somewhat smaller than frontal, its posterior point reaching a little beyond level of eyes; frontal as broad as long, the distance from oculars equal to distance between nasals, larger than interparietal; supraoculars larger than frontal, wider than deep; parietals much larger than frontal, separated by an interparietal, which is smaller than frontal; parietal not twice as wide as long; nasal with a swollen prominence about and above nostril, which gives the anterior head outline a roughened appearance; nostrils latero-inferior, not visible from above; nasal cleft issues from first labial and barely passes beyond nostril, not wholly dividing the scale; preocular not as wide as, and much shorter than, nasal, in contact with two labials; eyes dim, barely outlined; two postoculars, the inferior largest, in contact with fourth labial; four upper labials, fourth largest, first and second smallest, subequal in size; scales in 26 rows; tail ending in a sharp spine; 479 scales in a dorsal longitudinal line.

Color in life.—Above brownish to golden yellow, slightly lighter beneath. Very little distinction between the two colors as they merge gradually on the sides.

Measurements of Typhlops rugosa sp. nov.

Total length (mm.)	395
Tail (mm.)	23
Width of head (mm.)	7.5
Width of body (mm.)	8
Width of tail (mm.)	6.5
Body width in length (times)	50
Tail width in tail length (times)	3.54

Remarks.—Two other specimens besides the type were taken, an adult and a young. These two specimens were forwarded to Dr. Lawrence E. Griffin at the University of Pittsburg. They have not been at hand for comparison. All were taken in masses of fern roots growing in high forest trees. This species has no close affinities among the Philippine species unless *T. mindanensis* be regarded as such. From this it differs in the size of the frontal, which is larger than the prefrontal in *T. mindanensis*. One has two, the other three, labials touching the nasal. In one the head is very rough; in the other, comparatively smooth. Many other differences are obvious on a comparison of the two descriptions. The roughness of the head is not unlike that in *T. rossii* and *T. reginæ*, but here the resemblance ceases.

Trimeresurus mcgregori sp. nov. Fig. 1.

Type.—No. 748, Bureau of Science collection; collected on Batan Island, Batanes group (lying between Luzon and Formosa), June 12, 1907, by Richard C. McGregor.

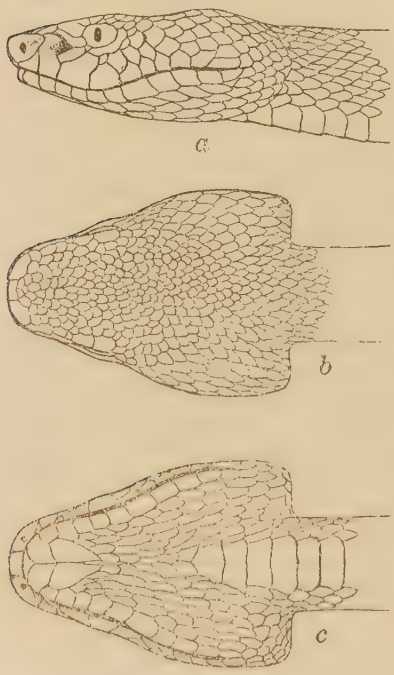

FIG. 1. *Trimeresurus mcgregori* sp. nov., from the type, × 1. *a*, head, lateral view; *b*, head, dorsal view; *c*, chin.

Description of type.—Rostral a little wider than high, slightly narrower at top, visible above as a narrow line, bordered behind by a rectangular scale, distinctly enlarged, which separates the two much enlarged supranasals; latter not or barely in contact with rostral, separated from anterior supraocular by three (four on right side) scales; two enlarged supraoculars followed by one or two small scales above eye; nasal single, large, triangular, visible above as a narrow line, the nostril, which is vertically oval, pierced near the lower border; canthus rostralis sharp, formed by the edge of nasal, the narrow elongate loreal following nasal, and superior preocular; facial pit surrounded by second labial, which forms anterior border of pit, and

middle and lower preoculars, which are much elongated; three preoculars; a narrow elongate subocular, as long as orbit; two or three postoculars; ten supralabials, first small, triangular, narrowly in contact with rostral; second high, reaching almost to canthus rostralis; third much the largest, broadly in contact with subocular; fourth and fifth scales separated from subocular, each by a single scale; temporal scales distinctly enlarged, larger than, or as large as, posterior labials; mental broadly triangular, wider than rostral; eleven lower labials, first, seventh, and eighth largest; a pair of large chin shields, much longer than wide, broadly in contact, bordered by three labials; 5 pairs of scales between chin shields and first ventral; 28 scales from angles of mouth across occiput; 13 scales between supraoculars; 29 scale rows on neck (at seventh ventral); 21 on body; ventrals, 175; 56 subcaudals; anal single; temporal scales perfectly smooth, body scales slightly keeled on the eight or ten median rows. Head rather angular, flattened above and depressed in supraocular region. Tail prehensile.

Color in life.—Above bright yellow with a darker yellow lateral streak; tail with a few small reddish brown spots near tip (in alcohol entire snake almost paper white with practically no trace of marking).

Measurements of type and cotype of Trimeresurus mcgregori sp. nov.

	Type. mm.	Cotype. mm.
Total length	865	702
Tail	120	100
Head width	25	25
Head length	36	33
Eye to end of snout	12	92
Eye to mouth	6	5
Supraocular width	16	14
Length of eye	4.5	4
Width of eye	3.2	2.8

Variation.—A second specimen from the same locality shows a certain amount of variation. The scale counts are as follows: Ventrals, 179; subcaudals, 59; scale rows on neck (at seventh ventral), 29; body, 21 rows; scales between eyes, 13; upper labials, 11–10; lower labials, 12; three scales behind supranasals bordering the rostral. On the right side the third labial does not touch the subocular; the lateral stripe covers one whole and a half scale rows.

Remarks.—This species belongs to the *T. gramineus* Shaw group, which includes *T. flavomaculatus* and *T. halieus*, of the

Philippines. It is differentiated from that group, however,[1] by the striking color with no dark markings, a larger number of scales on snout and supraocular region, and larger unkeeled temporals; the supranasals are larger and more clearly differentiated. Mr. McGregor, its discoverer and for whom I take pleasure in naming it, states that it is not rare on Batan Island. In a memorandum dated June 12, 1907, he says:

> Our party went to the summit of the mountain. On the return a large yellow snake was found resting at about 2 meters from the ground coiled on some leaves that had lodged among the thick stems of a kind of large grass.
>
> The snake was struck with an alpen-stock and fell to the ground. In attempting to put a string on its neck I was scratched by the fangs, between the last two joints of my thumb. Mr. H. G. Ferguson immediately made several cuts across the wound with a pocket knife and tied a string around the thumb. My hand and forearm were swollen by evening. The swelling subsided within a couple of days. There was very little pain, and no further trouble was experienced.

LIZARDS

Hemidactylus luzonensis Taylor. Plate I, fig. 2, *b* and *c*.

Hemidactylus luzonensis Taylor, Philip. Journ. Sci., Sec. D (1915), 10, 93.

This species was first described from a single mutilated female specimen. I have since examined several other specimens of this rare lizard. Four were presented to me by Dr. Edward S. Ruth, of the University of the Philippines. Several other specimens have been collected for the Bureau of Science collection.

Description of species.—(Adult male, No. 1620, E. H. Taylor collection; collected at Manila in 1916, by Edward S. Ruth.) Head flattened; snout rather oviform, more than twice as wide as deep, elongate, little less than twice the diameter of eye, one and one-half times the distance of eye from auricular opening; latter distinctly oblique on one side, rather vertical on the other; rostral squarish, upright, with a median notch and a cleft nearly half the depth of the scale; nostril pierced between rostral, first labial, two postnasals, and a supranasal; supranasals separated by two scales; ten upper labials, the last two very small; nine lower labials; mental triangular followed by two pairs of chin shields, first pair touching one labial and forming a long median suture; second pair in contact with first pair and two labials, but separated from each other by three scales; scales

[1] Compared with Stejneger's description of a Formosan specimen.

bordering upper and lower labials somewhat enlarged; scales on chin and throat small, those on abdomen imbricate and larger; snout covered with uniform granules, larger than those on occiput or body; occiput with scattered tubercular granules, rather conical; body with about sixteen irregular rows of trihedral tubercles; latter present on limbs; tail but slightly depressed, with whorls of sharply keeled spines marking annulations, about eight spines in transverse rows at base of tail; below enlarged, broadened, imbricate scales; regenerated part of tail without spines; limbs moderate, with digits all clawed, without any trace of webs, the distal phalanx rising from near end of toe; latter long, compressed, much deepened near end; nine divided lamellæ under longest toe, seven under longest finger; a distinct lateral fold from axilla to groin; a short series of femoral pores, five on one side, six on other side.

Color in alcohol.—The specimen is light yellow-brown with no evidence of marking save a dark spot on the snout.

Measurements of Hemidactylus luzonensis Taylor.

	mm.
Total length (tail regenerated)	123
Width of head	10.5
Length of head	18
Snout to vent	58
Foreleg	22.5
Hind leg	29.5

Variation.—The variation noted among specimens is largely in the markings. The live specimens examined usually exhibited a series of large dim dark blotches on the back, alternating with lighter markings. In most specimens the spiny tubercles on the back were white (see Plate I, fig. 2, *b* and *c*). The skin above the auricular opening forms an indistinct flap or fold (scarcely noticeable in preserved specimens), which is usually held distended in living or freshly killed specimens; this character is very evident and is shown in Plate I, fig. 2, *b* and *c*. The fold of skin on sides of body is prominent in living specimens and is shown clearly in the figure mentioned.

Remarks.—Evidently a rare form; most closely allied to *H. depressus* but easily distinguished by the longer snout, the character of the tail and the preanal pores, and the absence of webs on the feet. Known only from the Philippines.

Lepidodactylus naujanensis sp. nov.

Type.—No. 2006, E. H. Taylor collection; collected April 25, 1916, at Naujan Lake, Mindoro, by E. H. Taylor.

Description of type.—Rostral low, more than twice as broad

as high, not entering nostril; the latter surrounded by first labial and five nasal scales, forming a rounded prominence; postnasal bordering second labial, largest of the five; supranasals separated from each other by two series of three scales, all about the same size as nasal scales; a rather distinct groove on front end of snout; 13–14 upper labials, 13 lower labials; angle of mouth extends scarcely behind posterior vertical of eye; mental scarcely larger than adjacent scales, chin covered with a large number of somewhat enlarged scales, about 35, which fill all the space in front of a line drawn across jaw between the fifth lower labials, those bordering labials largest; granules on snout larger than those on body; back and sides covered with minute granular scales with scattered, slightly larger, spinelike scales, which are yellow; these also occur on the back part of head and neck; tail rather cylindrical, with a distinct lateral denticulated fringe, the annulations marked by an enlarged spinelike scale in the lateral fringe; scales on upper surface of tail distinctly larger than those on body, those on underside still larger; scales on belly imbricate, much smaller than those under tail; a long series of 25 preanal and femoral pores forming a median sharp angle; pores elongate in shape; limbs well developed, the adpressed hind leg reaches the wrist of the adpressed foreleg; web between toes and fingers very rudimentary; 14 lamellæ under longest toe; toes much wider at end than at base, the basal lamellæ rather scalelike; inner digits on limbs well developed, without claws; eye nearer ear than end of snout; ear slightly nearer eye than foreleg.

Color in life.—Reddish brown above with dim, zigzag, darker marking of brown across back; lighter at base of tail; a dark line between eyes and another on nose; sides dark with minute yellow spots; a more or less distinct row of yellow dots borders belly ventrolaterally; belly canary mixed with brown scales; underside of tail yellow at base, grayish at tip; lower part of eye dark.

Measurements of Lepidodactylus naujanensis sp. nov.

	mm.
Length	74
Snout to vent	34
Snout to foreleg	12
Tail	40
Axilla to groin	16
Foreleg	10
Hind leg	13.5
Width of head	5.1
Length of head	9.3

Variation.—Two other adult specimens were taken in the type locality. The following variations are in evidence. One specimen, a female, has 14–13 upper labials; 12 lower labials; the internasal scales are arranged with one large median scute, with a pair of smaller scales on each side; the angle of mouth fails distinctly to reach the posterior vertical of eye; no preanal pores, but a series of 12 enlarged scales on each side, angular medially, representing the pore scales; a series of distinct black spots on each side of tail just above the lateral fringe. The other specimen, also a female, has the internasal scales similar to those of the type save that the second row has 4 instead of 3 scales; upper labials, 13–14; lower labials, 12; calcareous deposits are present on the sides of neck.

On the opposite side of Mindoro, near Sablayan, another adult male specimen was taken. It agrees remarkably well with the type. The row of scales bordering the lower labials are distinctly larger than other chin scales. Preanal pores 12–11 in broad angular series; the body is gray with bronze-brown, irregular, zigzag markings.

Young.—Six pairs of small eggs were found attached to various trees under bark. These were brought to Manila, and with no special care ten young were hatched. These were very lively, but owing to my inability to obtain suitable food all died soon or were preserved. A male and female emerged from each pair of eggs; they were a uniform grayish brown; the largest measured 32.5 millimeters in length, the smallest, 29 millimeters.

The eggs are smooth, white, flattened on the two sides where they were attached to each other and to the trees. A great many of these eggs were found, but most of them were destroyed in removing them from their resting places.

Remarks.—This species is related to *L. christiani* Taylor, as shown by the arrangement of the nasals and the separation of the nostril from the rostral. It differs, however, in the development of the web between the toes; there is no skin fold on the femur, and the tail is essentially different.

The type and cotype, from Naujan Lake, Mindoro, were found under leaves of small climbing vines on trees. Other specimens observed escaped. The habitat is especially similar to that of the small *Siaphos kempi*, described from the same locality. On two occasions the two species were observed on the same tree. This species is probably common in the type locality.

Gekko mindorensis sp. nov. Fig. 2.

Type.—No. 499, E. H. Taylor collection; collected at Pocanil Point, Mindoro, May 4, 1916, by E. H. Taylor.

Description of type.—Head moderately large, rather oviform; distance from eye to snout somewhat longer than distance from eye to auricular opening; latter at least one-half diameter of eye, oval, distinctly oblique; rostral large, wider than deep, with a suture above, medially; nostril large, obliquely oval, surrounded by rostral, first labial, two subequal supranasals, and a postnasal; rostral forming the longest side of nostril; a single scale inserted between the two anterior supranasals; twelve upper labials; ten lower labials; the line of mouth makes

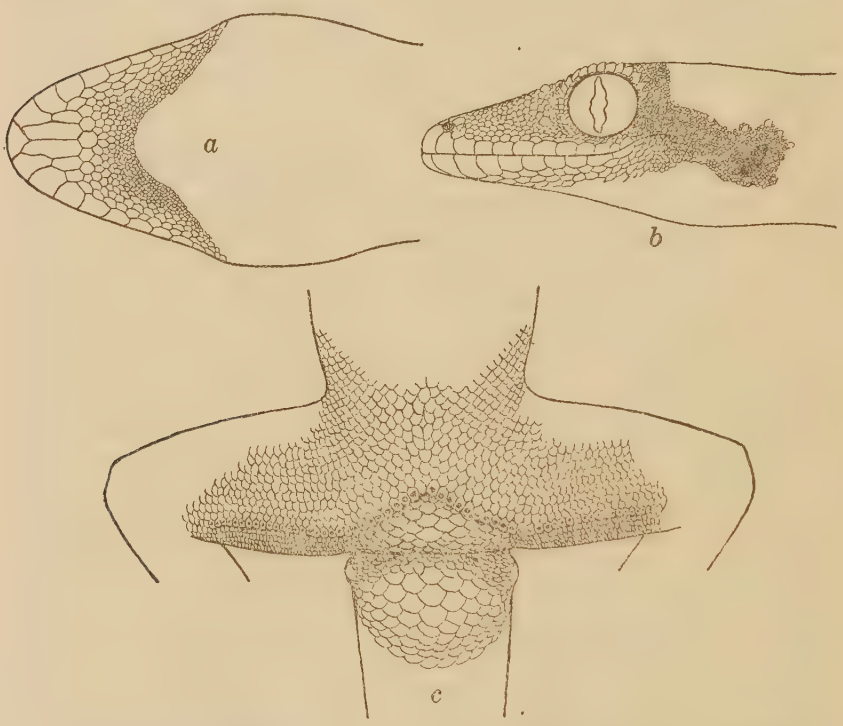

FIG. 2. *Gekko mindorensis* sp. nov., × 2. *a*, chin; *b*, head, side view; *c*, anal region.

a sharp angle upward immediately below eye; loreal regions covered with rather enlarged granules, largest immediately in front of eye; a row of enlarged granules bordering upper labials above; interorbital region and medial area on snout depressed, covered with much smaller granular scales; occipital region covered with minute granules interpersed with indistinct larger granules; mental triangular, followed by two elongate chin shields nearly three times as long as wide; a few enlarged pentagonal scales behind and at sides of chin shields; throat covered with equal-sized granules, larger than those on dorsal surface. Body rather slender, covered above with minute gran-

ules, intermixed with numerous rounding granules; an indistinct lateral fold; about 30 longitudinal rows of scales between the folds; preanal and femoral pores continuous, 27–28 on each side, slightly separated medially, a total of 55 pores. Tail regenerated wholly; above covered with fine granules, with no trace of annulations, below with irregular large broad scales; two enlarged tubercles at base of tail. Extremities moderate; toes not greatly dilated, about 16 lamellæ under longest toe; no rudiment of web evident.

Color in life.—Above almost uniform olive brown with but very little variation delineating the lighter and darker areas. No markings evident; below yellowish white.

Measurments of Gekko mindorensis sp. nov.

	mm.
Total length	162
Tail, regenerated	80
Snout to foreleg	34.5
Snout to vent	82
Snout to ear opening	22
Foreleg	30
Hind leg	40

Variation.—Eight other specimens have been studied, taken by myself about Naujan Lake, Mindoro. These specimens are all young; they are darker than the type, with blackish stripes across the backs and on the tails. Two males in the lot have 62 and 64 pores, respectively.

Remarks.—This species is related to *Gekko monarchus,* from which it differs as shown in the table of measurements. Several specimens of that species are at hand for comparison.

Comparative measurements of Gekko mindorensis and G. monarchus.

	G. mindorensis.	*G. monarchus.*
Snout to vent (mm.)	82	85
Foreleg (mm.)	26	29
Hind leg (mm.)	35	40
Width of body (mm.)	16	18
Width of head (mm.)	18	20
Diameter of eye (mm.)	6.5	5
Diameter of auricular opening (mm.)	3.3	2
Interorbital measurement (mm.)	6.75	8
Preanal and femoral pores	54	33
Scale rows across belly	30	45

Two males of equal size are compared. The ear-opening of *G. mindorensis* is larger, equaling half the eye. The eye itself is much larger than that of *G. monarchus;* the interorbital distance is less; there is a much larger number of preanal and

femoral pores, the number of scale rows across the belly is about fifteen less; the tubercles are fewer and much less prominent and the very characteristic markings of *G. monarchus* are wanting.

The type specimen was captured with the assistance of Mr. Clark Burks, of Sumagui, Mindoro; two eggs were found at the same time.

Oshima [2] has described *Gekko kikuchii* from Botel Tobago, Formosa, which seems to vary from *Gekko monarchus* in much the same way as does the present species. Although no specimens of the species are at hand for comparison the following differences are evident: *Gekko mindorensis* has many more femoral pores, 55 to 64, while 48 are recorded in *G. kikuchii;* the limbs are longer in the present species, and the basal web is wanting on the feet in both sexes.

Siaphos kempi sp. nov. Fig. 3.

Type.—No. 2016, E. H. Taylor collection; collected April 23, 1916, at Naujan Lake, Mindoro, by E. H. Taylor.

Description of type.—Head short, snout blunt, not especially depressed; rostral covering tip of snout, the part visible above much less than the depth of snout at the posterior border of rostral; no supranasals; frontonasal large, the suture with rostral equal to, or smaller than, that with nasal, and slightly larger than that with frontal; prefrontals much reduced, separated, not in contact with first supraocular; frontal moderate, about equal to frontoparietal in length, as long as its distance from end of snout, in contact with two supraoculars and first superciliary; frontoparietals fused in a single scale a little broader than long; interparietal triangular, a little wider than frontal, but shorter; parietals forming a suture behind interparietal; four pairs of nuchals; nasal pierced medially by nostril, touching a single labial; two frenals, both higher than wide; four supraoculars, last longest, second widest; eight superciliaries; several much enlarged temporals; seven upper labials, fifth below center of eye; five or six lower labials; mental larger than rostral; ear opening obliquely oval, moderately large; eye nearer tip of snout than ear opening; limbs small, barely touching when adpressed; digits not or but slightly compressed; 20 lamellæ under fourth toe; two enlarged preanals; median row of scales under tail slightly widened; 22 scale rows around body; scales smooth, the median dorsal rows widest.

[2] *Philip. Journ. Sci., Sec. D* (1912) 7, 241.

Color in life.—Above silvery olive to brown, somewhat lighter on tail; laterally a broad dark stripe from eye to near end of tail, becoming somewhat lighter on tail, bordered above and below with a narrow greenish silver line; head uniform dark brown; belly dirty greenish white with a few small specks of dark color under chin; underpart of tail creamy white; limbs mottled brown and yellowish.

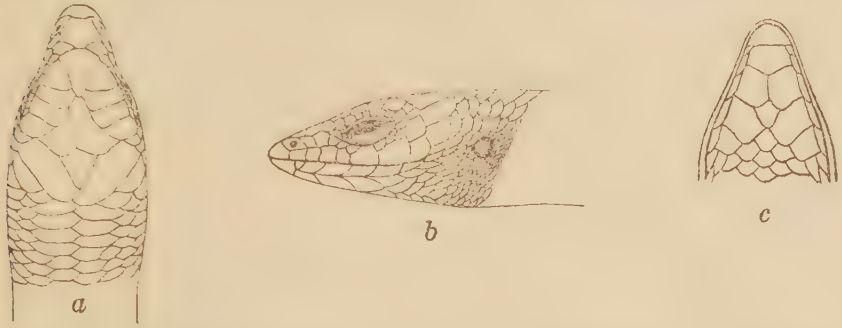

FIG. 3. *Siaphos kempi* sp. nov., from the type, × 4. *a*, head, dorsal view; *b*, head, lateral view; *c*, chin.

Measurements of Siaphos kempi sp. nov.

	mm.
Total length	93
Tail	53
Axilla to groin	21
Snout to vent	40
Snout to foreleg	14.5
Foreleg	9
Hind leg	14

Variations.—Two other specimens were taken in the same locality; both agree with the type in markings save that both are lighter above; they are practically identical in scalation.

Remarks.—This species appears to be intermediate between *Leiolepisma* and *Siaphos*. I have referred it to the latter rather than to the former genus because of its closer superficial resemblance to the other Philippine members of that genus and the fewer prefrontals and shorter limbs; the ear opening, however, is large and distinct. The known Philippine species of *Leiolepisma* have the divided frontoparietal; the three known species of *Siaphos* have the frontoparietal single.

The species is named for Ollie C. Kemp, Mangyan agent in Mindoro, who accompanied me on the collecting trip to Naujan Lake and assisted in making collections.

The species was found living under the leaves of small, close-clinging vines on trees. When these vines were loosened at the base of the tree and torn down, the lizards were revealed on the

sides of the trees at some distance from the ground and they immediately took refuge much higher up the tree; thus many specimens escaped. Only three specimens, brought down with the vines, were captured.

This species differs markedly from the two small species *Siaphos infralineolatum* Peters and *Siaphos quadrivitatum* Peters in size, markings, and the presence of an auricular opening. From the recently described *Siaphos auriculatum* Taylor, which it resembles greatly in markings, it differs in the presence of small prefrontals, and it probably does not grow so large. Many other differences are obvious on a comparison of descriptions and figures. Known only from the type locality.

Sphenomorphus lednickyi sp. nov. Fig. 4.

Type.—No. R 1992, E. H. Taylor collection; collected in June, 1917, on Masbate Island, by Victor E. Lednicky.

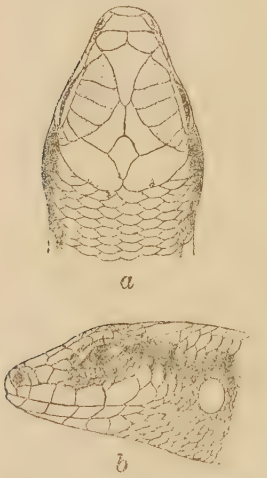

FIG. 4. *Sphenomorphus lednickyi* sp. nov., No. 291, E. H. T. collection, × 3. *a*, head, dorsal view; *b*, head, lateral view.

Description of type.—Rostral only slightly visible from above, forming a broad, rather curved suture with frontonasal; latter much broader than deep, broader behind than in front, in contact with anterior frenal; prefrontals large, broadly in contact, touching both frenals laterally, not in contact with first supraocular; frontal as wide as, or slightly less than, the supraocular region, in contact with first superciliary and two supraoculars, narrowed behind; frontoparietals distinct, rather elongate, broadly in contact; interparietal much longer than wide, with a distinct eyespot; parietals forming a suture behind interparietals; no nuchals present; five supraoculars, last very small, first deepest, second widest; nostril pierced in a single nasal; no supranasals; anterior frenal not as high as nasal, much higher than wide; second frenal wider at top than bottom, lower than anterior; three preoculars superimposed, between first superciliary and third labial; six upper labials, fourth and fifth under eye, but separated from orbit by several scales; third labial smaller than second; five lower labials; mental small, followed by a very wide postmental; three pairs of chin shields, only first pair in contact; four enlarged temporals, that bordering parietal largest; auricular opening very large; tympanum very superficial; 40 rows

of scales around belly; scales on sides in longitudinal rows, all rows subequal in size; preanal scales distinctly enlarged; limbs well developed, the adpressed hind leg reaching wrist of foreleg; latter brought forward reaches middle of eye; 22 lamellæ under longest toe; scales below tail scarcely broadened; eye a little nearer end of snout than ear; latter nearer foreleg than end of snout.

Color.—Head and body variegated brown above with dark areas over supraocular region and a median row of irregular black dots, extending somewhat on tail; a heavy black stripe begins behind eye and continues as a broken series of irregular spots along side of body and tail above legs; legs brown, with black variegations and a light spot on knee; toes barred with black; throat and labials muddy white; belly light cream; tail below with dark flecks; a few cream yellow spots above and below the black stripe on neck.

Measurements of Sphenomorphus lednickyi sp. nov.

	Type. mm.	Cotype. mm.
Total length	106	114
Snout to vent	46	50
Snout to foreleg	18	18.5
Tail	60	64
Axilla to groin	27	28
Width of head	7	8
Length of head	8.6	8.5
Foreleg	15	14
Hind leg	21	22.5

Variation.—A second specimen from the same locality agrees in scalation, but the head is broader, and the broad black stripe is almost wanting along the body. The regenerated tail has broad scales above and below.

Remarks.—The two specimens were collected in Masbate, near the Aroroy gold mines, by Mr. Victor E. Lednicky. He states that they appear to be plentiful in that locality. Superficially this species resembles *Sphenomorphus curtirostris,* but the latter has the frontoparietal single, fourteen lamellæ under longest toe, more upper labials, and the nasal followed by superimposed frenals. It is a larger species. I take pleasure in naming the species for its discoverer.

Sphenomorphus llanosi sp. nov. Plate II.

Type.—Santo Tomas Museum, Manila, specimen unnumbered, collector unknown. Probably from Luzon.

Description of type.—Habit lacertiform; snout narrower and

longer than in *Sphenomorphus jagori;* rostral much wider than high, much narrowed laterally in front of first labial below nasal; frontonasal little broader than deep, forming a straight suture with rostral, laterally in contact with upper anterior frenal, posteriorly in contact with frontal; prefrontals rectangular, separated in the middle, in contact laterally with upper anterior and posterior frenals, and a single superciliary; frontal much elongate, narrowed behind and in front; distance between supraocular regions about one-third the width of the region above one eye; frontal little shorter than frontoparietal and interparietal length, in contact with two supraoculars; frontoparietals slender, pointed in front, forming a common suture much more than half their length; interparietal nearly as broad as frontal, but not nearly as long, as large as frontoparietals; parietals large, in contact behind interparietals, touching last supraocular and two small postoculars; no nuchals; nasal quite large, the scale placed diagonally, touching only one labial; two anterior frenals superimposed, the two not as high as nasal, but higher than the very large frenal following, which is much wider at top than bottom, touching two labials; two preoculars, the lower largest, followed by two moderately large scales below eye, the second partly wedged between fifth and sixth labials; ten superciliaries; five large supraoculars followed by two paired scales, the first supraocular more than a third of the length of the supraocular region, second widest; nine upper labials, sixth below orbit, sixth and seventh largest; five distinctly enlarged temporals, the largest bordering parietal; eight or nine lower labials; one unpaired postmental; two paired chin shields, first pair in contact, second separated by one scale; anals enlarged; 23 lamellæ under longest toe; ear opening moderate, vertically oval; 42 scale rows around middle of body. Adpressed hind leg reaches beyond elbow of adpressed foreleg; adpressed foreleg reaches anterior corner of eye.

Color in alcohol.—Above rich, reddish brown traversed by about thirteen indistinct bands of light, black-edged dots on back, and continuing on tail; behind eye to above foreleg is a large, broad, dark brown stripe bordered below by a white stripe, which begins on second labial and continues back to ear, then widens and takes a backward and downward course to foreleg; below this there is a rather irregular mottled area of brown; lower labial flecked with brown; limbs above mottled with elongate light spots; sides somewhat lighter, flecked with brown; a brown

area above hind limb; below yellowish; there is a very dim row of brown spots along upper lateral region.

Measurements of Sphenomorphus llanosi sp. nov.

	mm.
Total length	148
Tail (end regenerated)	60
Foreleg	16
Hind leg	26
Axilla to groin	27.5
Snout to foreleg	21.5
Snout to eye	5
Eye to ear	5.2
Ear to foreleg	8.5
Width of head	9

Remarks.—Closely related to *S. jagori,* but differs in the following points: The first frenal is divided and the scales superimposed; the second frenal is proportionally much larger; there are five instead of four large supraoculars; the frontoparietals are slenderer and extend farther forward; the coloration is also distinctive; there are more rows of scales about the body.

Unfortunately the collections in the Santo Tomas Museum are unnumbered, and for the most part are without authentic localities. It is highly probable that this species is from Luzon, and perhaps the northern part of the island. Only a single specimen, the type, is present in the collection. I take pleasure in naming this species in honor of Father Florencio Llanos, director of the University of Santo Tomas, who has generously permitted me to study the collections in the museum of the university and to describe the new species.

ILUSTRATIONS

PLATE I

FIG. 1. *Typhlops longicauda* sp. nov., from the type, × 5. *a*, lateral view; *b*, dorsal view; *c*, ventral view.

2. *a*, *Hemidactylus frenatus* Duméril and Bibron; *b* and *c*, *Hemidactylus luzonensis* Taylor.

PLATE II

Sphenomorphus llanosi sp. nov., from the type, about × 1.5.

TEXT FIGURES

FIG. 1. *Trimeresurus mcgregori* sp. nov., from the type, × 1. *a*, head, lateral view; *b*, head, dorsal view; *c*, chin.

2. *Gekko mindorensis* sp. nov., × 2. *a*, chin; *b*, head, lateral view; *c*, anal region.

3. *Siaphos kempi* sp. nov., from the type, × 4. *a*, head, dorsal view; *b*, head, lateral view; *c*, chin.

4. *Sphenomorphus lednickyi* sp. nov., × 3. *a*, head, dorsal view; *b*, head, lateral view.

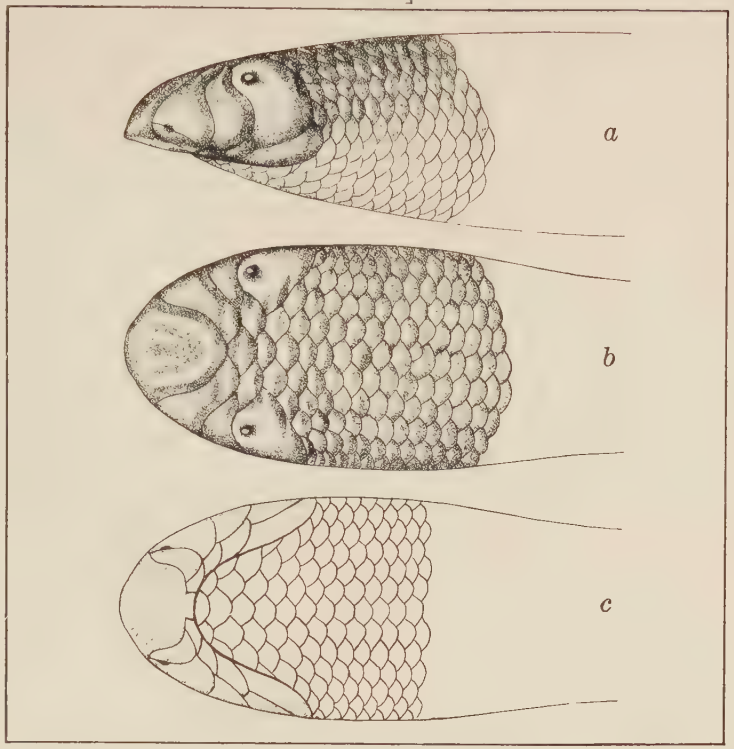

Fig. 1. Typhlops longicauda sp. nov., from the type, × 5.

Fig. 2. *a*, Hemidactylus frenatus Duméril and Bibron; *b* and *c*, Hemidactylus luzonensis Taylor.

PLATE I.

PLATE II. SPHENOMORPHUS LLANOSI SP. NOV., FROM THE TYPE, ABOUT × 1.5.

IPON FISHERIES OF ABRA RIVER

By Edward H. Taylor

(From the Section of Ichthyology, Biological Laboratory, Bureau of Science, Manila)

On the western coast of Luzon as well as in numerous other parts of the Philippines there are several annual runs of the young of a small fish of the family Gobiidæ, known to the Ilocanos as *ipon* or *hipon*.[1] At stated seasons they appear along the shore and attempt the ascent of the rivers, where they attain adult size. The adults reach a length of from 8 to 10 centimeters; the young when taken are usually less than 2 centimeters in length. In spite of the very small size of these fishes the catch in the Philippines is so large that the industry is of marked economic importance.

The ipon fisheries of Abra River, which are typical of the ipon fisheries of other places along the Luzon coast, are probably the best illustration of this important industry.

Abra River rises in the highlands dividing Kalinga Subprovince, Mountain Province, from Abra Subprovince, Ilocos Sur. It is fed by several fairly large streams, which carry much water during the rainy season. It emerges from the mountainous plateau of Abra through a narrow gap in the coast range about 12 kilometers from the sea. Here on the coastal plain it spreads out in fan shape, to lakelike dimensions, entering the sea through several mouths. In its upper reaches it probably attains considerable depths, since several soundings of more than 10 meters' depth were made. However, it frequently descends over long stretches of gravel and small bowlders, with a depth of from 1 to 2 meters. During the dry season the depth at the various mouths is slight, probably averaging about a meter. The provincial road crosses the river very near the mountain gap. Here the river is about 0.4 kilometer wide, and the depth does not exceed 2.5 meters during December.

The ipon of Abra River that were taken during November were the young of a small goby which when full grown does not attain a length of more than 10 centimeters. During the greater

[1] In many of the Filipino dialects the names *ipon* and *hipon* are applied to small shrimps or prawns, species of which are found in both fresh and salt water.

part of the year it is found in the fresh water of lakes and rivers. At certain seasons it descends to the sea to spawn, probably about the month of June, for the young ipon make their first appearance along the coast during September, rarely in August.

According to substantiated report the young arrive near the coast nine days after the first full moon in each month from September until February. Fishing begins along the coast as soon as the fish are sighted, in water from 2 to 10 meters deep. The sea catch is of superior quality and brings the highest prices. However, shore fishing is profitable for only three days, because during these three days the fish have entered the river and may be caught by nets and traps. The river fishing lasts several days after the shore fishing has ceased to be profitable. The value of the fresh-water catch quickly diminishes. The fresh water has a tendency to turn the living fish dark, and as the flesh darkens it acquires a somewhat bitter taste. The fish when full grown has a fair flavor and when fried crisp is quite palatable. After a few days the river catch has lost entirely its commercial value, and the fishermen await the next monthly run. The number of adults captured for food is negligible.

The two most important methods of taking the fish are by means of a special net, known as *daclis de ipon*, and a small trap, known locally as *sarep*. The former is the more important. It is a large affair, averaging 60 to 100 meters in length and 8 to 12 meters in depth. It is composed of many pieces of abacá or maguey cloth sewn together lengthwise and resembles a huge piece of patchwork, varying in shade from yellow to brown. Brails are attached at the ends; the tops are well corked; the bottoms are leaded heavily, and the leads are concealed by several long ropes running lengthwise and securely fastened together. These ropes seem to prevent the bottom of the net from becoming readily entangled with objects on the sea bottom. The net is used near the river mouth in water as deep as 12 or 14 meters. During a run of the ipon, a good haul will often bring in as many as 10 cavans;[2] the usual haul is less.

From January 1 to November 1, 1916, the town of Caoayan lying at the mouth of the river, licensed one hundred thirty-six of these nets, daclis de ipon (or *chinchorros para ipon*, as designated on the tax ordinance). Each net of this type is taxed annually 10 pesos,[3] thereby bringing to the tax income of the

[2] One cavan equals 75 liters.

[3] One peso Philippine currency equals 50 cents United States currency.

town 1,360 pesos per annum. Each net over 60 meters in length has a marketable value of 300 pesos or more; thus the nets represent a property value of at least 40,800 pesos.

The sarep is a small cylindrical trap made of finely woven bamboo and is about 1 meter long by 25 centimeters in diameter; at one end it tapers to a narrow cyclindrical mouth stopped by a cork about 5 centimeters in diameter. The other end is furnished with a funnel-shaped mouth, which extends within for about one-third of the length. These traps are set in the river near the various mouths where the water is shallow or where there are riffles, as many as two hundred being placed side by side in certain designated places. The places where sarep may be used are fixed and classified by the municipal councils. These places are designated as "first class" and "second class." For a first-class location the minimum tax is 12 pesos per annum; but these places are usually sold at auction, the best localities bringing as much as 40 pesos each. The minimum for the second-class locations is 6 pesos per annum.

The auctioning of locations is frequently the occasion of much dissension among the fishermen, at times resulting in fights.

The catch for the most part is made into the popular fish food, known as *bagoong*.[4] To make bagoong the fish are laid in layers in large earthen jars called *tinajas*, a layer of salt between two layers of fish. This mixture is then stored away and allowed to ferment into an evil-smelling substance, which is greatly relished by many Filipinos. The liquid portion obtained from the mixture is used for a sauce and is usually eaten with rice, while the more solid part of the ferment is heated or fried and eaten as ordinary fish. The proportion of salt and fish varies; according to Seale[5] the proportion is two parts of fish to three parts of salt for certain varieties of bagoong. This is certainly a much higher percentage of salt than is used or required for the bagoong made of ipon.

The fisheries at the mouth of the river are in the hands of the two municipalities of Santa and Caoayan. In the two towns the taxes on the fishing industry alone amounted to 3,224.39 pesos for 1915, and the collections for 1916 up to December 1 amounted to 3,220.15 pesos. Not all of this represents tax on the ipon fishery, but certainly a large part of it does, since

[4] Bagoong is a generic term applied to a number of preparations made from small fish or shrimp. It is usually known as *guinamos* in Visayan dialects.

[5] Seale, Alvin, *Philip. Journ. Sci., Sec. D* (1914), 9, 4.

according to a previous paragraph the taxes on the daclis de ipon in the town of Caoayan alone, not including the sarep localities, amounted to at least 1,360 pesos.

A conservative estimate of the value of the ipon fisheries of Abra River based on the average of the catches of individual fishermen, on the estimates of various officials and traders, and on the taxes for the nets and traps for catching ipon, amounts to well over 350,000 pesos annually. Various estimates made by the municipal treasurers and secretaries were invariably between 400,000 and 500,000 pesos. These last estimates are too large, save during exceptional years, as the size of the catch varies from year to year.

To use this fish for canning would be feasible. Without doubt such a canned product would find a ready sale in interior towns. Possibly it might take the form of a paste such as the anchovy paste now found in European and American markets, or the ipon might be preserved in a piquant sauce and used as a relish with curry or preserved in oil and used the same as salmon and other fish products.

Appended is a statement obtained from the Provincial Treasurer of Ilocos Sur of tax receipts for towns along Abra River.

TABLE I.—*Statement of collections on fisheries of the municipalities along Abra River.*

Municipality.	1914	1915	1916	1916 up to—
	Pesos.	*Pesos.*	*Pesos.*	
Bangued, Abra	21.55	21.75	17.05	Nov. 30.
Bucay, Abra	62.56	70.20	43.00	Oct. 31.
Caoayan, Ilocos Sur	1,903.90	2,087.16	2,333.31	Nov. 30.
Dolores, Abra	5.91	14.88	7.13	Sept. 30.
Piotiojan, Abra	10.00	10.00	11.00	Oct. 31.
Pilar, Abra	33.60	14.60	----------	Sept. 30.
Santa, Ilocos Sur	1,048.49	1,187.23	986.04	Nov. 30.
Tayum, Abra	44.00	62.00	53.00	Nov. 30.
Two towns of Ilocos Sur at mouth of river	2,957.39	3,224.39	3,220.15	[a] 9,396.93
Six towns on upper river in Abra	177.62	193.13	131.18	[a] 501.93

[a] Total for three years.

PHYTOPHTHORA FABERI MAUBL.: THE CAUSE OF COCONUT BUD ROT IN THE PHILIPPINES

By Otto A. Reinking

(*From the Agricultural Experiment Station, College of Agriculture, Los Baños*)

THREE PLATES

The cause, and the method of spread, of coconut bud rot, which produces severe losses in all parts of the tropics where coconuts are cultivated have been subjects of investigation. Various organisms have been considered responsible for the disease. Because of this diversity of opinion, extensive work has been done by the writer to determine, if possible, the organism responsible for the disease in the Philippine Islands. Although these studies are still in progress, sufficient evidence has been obtained to make it seem advisable to present in a preliminary paper the most important conclusions that have been reached. Before adequate control measures can be devised to reduce the damage done by this disease, it is of the utmost importance that the causal organism and its methods of dissemination be definitely known. The work already done has been sufficient to establish the identity of the organism responsible for the disease in the Philippine Islands.

HISTORY OF THE DISEASE IN THE PHILIPPINES

In March, 1908, the first authentic and reliable investigations into the bud-rot situation in the Philippines were conducted by Copeland.(5) The disease was reported as prevalent in the coconut sections of Laguna and Tayabas Provinces, being especially severe in the regions surrounding Lilio and Nagcarlan; and some cases were observed on the mountain slopes near the town of Tayabas. In the vicinity of Nagcarlan, it had been reported as being serious for a period of ten years preceding these studies. Due to these investigations ordinances were enacted in Laguna Province whereby all the infected trees were to be cut down and burned, in order to check the advance. In the latter part of the same year Byars,(3) of the Philippine Bureau of Agriculture, visited the affected regions for "the in-

spection of these provinces with a view to eradicating the bacterial disease known as 'bud-rot of the coconut'." On this trip Byars found the disease to be most prevalent around the base of Mount Banahao in the municipalities of Nagcarlan, Lilio, and San Pablo. It was reported that more than two thousand trees had been destroyed in one of the barrios of Nagcarlan. In March, 1911, Roxas(11) in a report on the cultivation of coconut mentions the bud rot as being probably due to bacteria. Cevallos,(4) in 1911, discussed control measures for the bud rot that had been observed some years ago. In 1912 Barrett(1) wrote of the infection as being by far the most serious of all the fungus or bacterial diseases that trouble the coconut planter. In 1916 the first extensive means for combating the bud rot were inaugurated by the Bureau of Agriculture under the direction of Mackie.(8) The work "was designed to furnish information as to the spread and the prevalence of disease and, if possible, to ascertain the pathogenic agent, and the means of distribution." The inspections were confined largely to the coconut belt in central Luzon, in Laguna and Tayabas Provinces. New ordinances were passed, and the Bureau of Agriculture was charged with inspection and destruction of infected trees. Little was learned, however, concerning the cause and manner of its spread. A bacterium was reported to have been isolated from affected trees, and from palm weevils that attack the trees, and an attempt was made to prove that the insects carried the organism and spread the disease. No inoculation studies were performed. Wester,(12) in a paper on coconuts, cited Reinking, of the College of Agriculture, as having isolated a bacterium which produced disease when inoculated into healthy trees. The latter, in a report on Philippine economic-plant diseases,(9) under the discussion of bud rot, stated that a diseased condition could be produced by a specific bacterium.

From this resumé of the literature in the Philippine Islands it may be seen that very little work has been reported on the causal organism, and that the general opinion has been that a bacterium was the cause of the disease.

Johnston,(7) after an extensive piece of work on coconut bud rot, arrived at the conclusion that the disease in the West Indies was caused by a bacterium similar in most respects to *Bacillus coli* (Escherich) Migula. Butler(2) has presented evidence to prove that the disease on palms in India was produced by *Pythium palmivorum* Butler. In other sections of the world various fungi have been associated with the disease.

For the past two years the writer has made a study of the

rot with the aim of determining the causal organism. Until the present investigations were started, no accurate and definite study was made of the organism which causes the coconut bud rot in the Philippines. The report as here presented is only a preliminary one; a complete work on the bacterial and fungus phases will be prepared at a later date. Preliminary tests indicated that the disease might be due entirely to bacteria; but more extensive studies proved that bacteria could not account for the severity of the disease observed under field conditions. On March 11, 1919, from a diseased tree kindly sent in by the Bureau of Agriculture, a fungus was isolated which was proved to produce disease in all seedlings inoculated. This work, taken in connection with inoculation studies with *Phytophthora faberi* Maubl. isolated from cacao pods, appears to the writer to furnish conclusive evidence that the primary agent in the production of the infection is a fungus; and that bacteria, while always associated with severe cases of the disease, are to be regarded as secondary agents.

DISTRIBUTION OF THE DISEASE

In the Philippines, according to the Bureau of Agriculture reports for 1916 by Mackie,(8) the disease was found in Laguna, Tayabas, Batangas, Pangasinan, Tarlac, Albay, and Ambos Camarines Provinces; and it was reported as occurring in Misamis, Capiz, Samar, and Bohol. The report of the Bureau of Agriculture for the year 1917–18, submitted by Mr. G. Merino, states that the disease is also prevalent in Zamboanga. The infection is most severe and widespread in those sections of the Islands in which the climatic conditions afford a very moist atmosphere. Thus coconut bud rot is very abundant in the upper belt of the coconut country about Mount Banahao. The studies made by the writer were concerned principally with this section.

An extensive discussion of the rot as it occurs in other parts of the world has been given by Copeland(6) and by Johnston.(7)

NATURE OF THE DISEASE

General diagnosis.—The first symptom is a withering of the youngest unfolded leaf, followed by the leaf turning brown. Gradually the next younger leaves wither and turn brown, until the entire central group is affected. At this stage the central leaves may be easily pulled out. Frequently, in advanced cases, they fall over (Plate I, figs. 1, 2, and 3). About this diseased central portion is a fringe of older leaves, which are perfectly healthy and remain upon the tree for months after infection.

It appears that trees are most commonly infected when they first come into bearing. The young nuts on a bearing tree attacked remain small and fall off prematurely.

Internal symptoms are very characteristic. The fungus apparently gains entrance into the soft tissue, usually called the "cabbage," through the youngest leaves. In the early stages a longitudinal section of the bud shows that the disease may start in young leaves, at a point where they begin to unfold (Plate II, fig. 1). At this point a spotting of the leaf is first noticed; then the organism works downward, causing a soft rot and browning of the group of unfolded leaves. The upper exposed portions of these die and turn brown, due to the rotting beneath. The rot advances downward to the growing point and then spreads into the soft tissue below. From here it invades the woody parts, usually not penetrating farther than from 5 to 10 centimeters. In the early stages no discoloration is produced in the growing point and "cabbage," but a dark red to brownish line always marks the limits of the advance in the woody parts (Plate II, fig. 4). The organism does not penetrate readily into the old leaf sheaths surrounding the young, tender, developing portions (Plate III, figs. 1, 2, and 3). The rot is commonly checked when it reaches the firmer tissues of the trunk though, in advanced cases, it may penetrate about 20 centimeters (Plate III, figs. 1 and 2). The affected portion in the trunk may become greatly softened; this is shown by the fact that the finger can be pushed into the diseased part. There is present a putrid, somewhat sour odor. The most advanced stages are characterized by the change of the white "cabbage" into an ill-smelling, semiliquid mass. A portion of the trunk below becomes a softened group of fibers.

Spread and loss.—The disease spreads very rapidly from tree to tree, but the manner in which this is accomplished has not been thoroughly investigated. Wind and insects are probably the most important agencies. In one barrio under observation, fifty-eight new infections appeared within one year after an inspection in which all attacked trees found had been cut down and burned. The disease may have started from trees unobserved during the first examination. The trees were located in the upper extremities of the coconut region on the slopes of Mount Banahao, where the atmosphere is very moist and where thick planting is practiced. Both conditions are favorable for the development and spread of the organism.

Up to September 30, 1918, according to reports of the Bureau of Agriculture furnished the writer by Mr. José Sanvictores,

12,813 coconut trees had been found affected in Laguna, Tayabas, Pangasinan, and Zamboanga Provinces. The largest number was found in the first two provinces. Since each tree is valued at not less than 10 pesos, the entire loss, not including early losses and the cost of inspection and burning of affected coconut trees, has been 128,130 pesos. The number of trees destroyed will undoubtedly be lessened by a thorough system of inspection and eradication of diseased trees. Future examinations ought to show a lower proportion of infection.

INVESTIGATION OF THE DISEASE

FIELD STUDIES

Careful study has been made of more than thirty typical cases in the field. These diseased trees were cut down and the buds opened for observation. Judging from macroscopic examination the infection appeared to be due to bacteria. Portions of infected trees were collected and placed in sterile vials for transporting to the laboratory. In addition to these studies, work was done with diseased specimens sent to the College of Agriculture by the Bureau of Agriculture.

LABORATORY STUDIES

Bacterial.—During the first part of the investigation microscopic examinations, in the majority of cases, failed to reveal the presence of mycelia. Bacteria, however, were always present in abundance. Diseased pieces, which had been collected under sterile conditions in the field and placed immediately in sterile vials, usually developed no fungi; but they were completely overgrown with bacteria. Later studies have indicated that, in these cases, the bacteria multiplied rapidly and destroyed the slower-growing fungus that probably was present. The only fungi observed in the earlier studies were saprophytic forms.

Cultures were obtained by cutting and plating small pieces from all parts of infected trees, specimens being taken from the tip of the unfolded infected leaves down to the growing point and the woody tissue below. A mixed culture of bacteria was present in the majority of these cases. In very young stages of infection, and in tissues into which infection has advanced farthest, only one kind of bacterium may be present. Such cases were usually not obtained, probably because saprophytic bacteria are soon washed down into the infected parts and there find a favorable place for development. Since no specific fungus was isolated in the first studies, and bacteria

were always present, inoculation experiments were conducted with them in order to test their virulence.

The inoculations were made chiefly with seedling coconuts from 60 to 180 centimeters in height. They were prepared by stripping off the outermost leaves. Then the outside of the portion to be inoculated was washed with mercuric chloride, 1 to 1,000, and after ten minutes was rinsed with sterilized water. With a sterile scalpel a stab was made into the growing point, and a pure culture of the bacterium introduced with a platinum needle. The injured portion was then covered with melted paraffin. Controls were prepared in the same manner except that sterile water was used in place of the bacteria. About three hundred inoculations have been made in this manner, and in a number of instances cases of bud rot were produced (Plate II, figs. 5 and 6). Employing this method, saprophytic bacteria were eliminated, because of their failure to produce disease. After the elimination of these saprophytic forms, there remained one distinct kind of bacterium that would produce disease under certain favorable conditions, such as severe injury of the growing point, and excessive dampness. Inoculations were not repeatedly successful, but when the exact requirements were met a number of positive infections could be obtained. Bacteriological tests have shown that the organism thus isolated and used for inoculations was similar to *Bacillus coli* (Escherich) Mig., and apparently is identical with that considered by Johnston(7) to be the cause of coconut bud rot.

Authenticated cultures of *Bacillus coli* (Escherich) Mig. were obtained from Dr. L. R. Jones, of the University of Wisconsin, and also from Dr. O. Schöbl, of the Philippine Bureau of Science. The cultures from the United States were isolated from man, and those secured in the Philippines, from man and horse. Under extremely favorable conditions a bud rot could be produced with each of these cultures. The infections produced from the first inoculations were very slight; but the organism, after it was reisolated and then used for reinoculation, appeared to produce a more rapid and severe case of rot. This may indicate that the bacteria increase somewhat in virulence after passing through a weakened tissue.

Cytological studies also have shown the presence of bacteria in the tissues of the coconut. Sections of a typical case were made from parts of the young leaves near the growing point, from portions of the growing point, and from the woody tissue. These sections show that the organism is present not only in the parenchymatous tissue, but also in the vascular system.

The bacteria are present in the xylem tubes of the young leaves, and of all the parts down to the woody tissue. This probably accounts for the rapid spread of the bacteria.

Thus bacterial studies have proved that under certain very favorable conditions *Bacillus coli* (Escherich) Mig., and a similar organism isolated from coconut trees, may produce disease. A summary of the entire bacterial investigations has indicated that, although the bacteria are always present and account for the destruction of a portion of the weakened tissues, they can not explain the prevalence and rapid spread of the disease. Further researches have been conducted in order to ascertain whether or not a fungus is present and is the primary agent in the production of the disease.

Phytophthora faberi Maubl. studies.—While the investigations of coconut bud rot were in progress, studies were also being conducted with *Phytophthora faberi* Maubl. isolated from cacao. The latter organism proved not only to cause the black rot of cacao pods, the rot of papaya fruit, and the canker of cacao and Hevea rubber, but also to produce an infection in a number of other hosts as well. Table I gives a summary of these inoculations.

TABLE I.—*Infection experiments with Phytophthora faberi Maubl. isolated from the black rot of cacao pods.*

Seedlings killed by the organism:
- *Annona muricata* L. Guanabano; soursop.
- *Hevea brasiliensis* (H. B. K.) Muell. et Arg. Para rubber.
- *Spondias lutea* L.
- *Theobroma cacao* L. Cacao.

Infection confined to wounds:
- *Annona glabra* L.
- *Artocarpus odoratissima* Blanco. Marang.
- *Artocarpus integra* (Raderm.) Merr. Jack fruit.
- *Averrhoa bilimbi* L. Camias.
- *Eugenia jambolana* Lam. Duhat; lumboy.
- *Lansium domesticum* Jack. Lansones.

Fruit rot produced:
- *Carica papaya* L. Papaya.
- *Theobroma cacao* L. Cacao.

Because of the omnivorous habit of this fungus, and since various countries in the East, notably India, have reported that coconut bud rot has been produced by a Phycomycete, *Pythium palmivorum* Butler,(2) it was deemed advisable to try inoculations with *Phytophthora faberi* Maubl. isolated from cacao pods. As is shown by the inoculation experiments presented in Table II, a large percentage of the trees became diseased.

TABLE II.—*Coconut inoculation experiments with Phytophthora faberi Maubl. from cacao.*

Tree.	Date.	Character of inoculation.	Observations.		Reisolation.
			Severe rot.	No rot.	
	1918.		1918.	1918.	
1	Oct. 4	Stab; damp chamber		Oct. 15	
2	do	do	Oct. 15		+
3	do	do	do		+
4	do	do		Oct. 15	
5	Nov. 11	do	Nov. 21		+
[a]6	Aug. 16	Stab; outside in shade		Oct. 15	
7	Aug. 26	do	Sept. 20		+
8	Nov. 18	do	Dec. 4		+
9	Dec. 10	do	Dec. 16		+
10	do	do	do		+
[a]11	Nov. 18	do		Dec. 16	
	1919.		1919.		
12	Jan. 13	do	Jan. 26		+
13	do	do	do		+
				1919.	
[a]14	do	do		Jan. 16	
	1918.		1918.		
15	Nov. 20	do	Nov. 26		+
16	do	do	do		+
				1918.	
[a]17	do	do		Nov. 26	
18	Nov. 22	do	Dec. 10		
19	do	do	Dec. 7		+
20	do	do	Dec. 10		
[a]21	do	do		Dec. 10	
	1919.		1919.		
22	Jan. 21	do	Jan. 29		+
23	do	do	do		
				1919.	
[a]24	do	do		Jan. 29	
25	Jan. 8	do	Jan. 16		+
26	do	do		Jan. 16	
[a]27	do	do		do	
28	Jan. 13	Uninjured; outside in shade		Jan. 26	
	1918.		1918.		
29	Nov. 20	do	Nov. 26		+
				1918.	
30	Dec. 13	do		Dec. 30	
31	do	do		do	
32	do	do		do	
[a]33	do	do		do	
	1919.			1919.	
34	Jan. 8	do		Jan. 16	
			1919.		
35	Feb. 3	do	Feb. 18		+
36	do	do		Feb. 18	
[a]37	do	do		do	
38	Feb. 20	Stab; mature tree outside	Apr. 7		+
39	do	do	(b)		
[a]40	do	do	Apr. 7		

[a] Control. [b] Not as yet examined.

The infection was extremely rapid; when the seedlings were placed in a damp chamber, severe disease occurred a few days after inoculation. The same method of inoculation was used as that described under bacterial studies. Of five cases infected by the stab method and placed in the damp chamber, three developed severe cases of bud rot. Of fifteen seedlings inoculated in the same manner, but placed outside in the shade, fourteen developed the disease. Eight seedlings were inoculated by merely placing the fungus between the young unfolded leaves near their tips; these seedlings were placed in the shade and two developed the infection. Trees 38, 39, and 40 were large, mature trees in a coconut grove. They were prepared in the same manner as the seedlings, except that an auger was used to make an opening, into which the fungus could be inserted. Tree 38 developed a typical case of bud rot. The other inoculated tree, No. 39, is still under observation. In every case the controls remained perfectly healthy. The fungus was reisolated from all diseased seedlings except from Nos. 18, 20, and 23. These experiments prove that *Phytophthora faberi* Maubl. from cacao may produce disease by invading directly the young uninjured leaves, but that infection takes place more readily through injuries.

The fungus spread in all directions, above and below the wound; it was not confined to the tender young leaves, but penetrated older leaf sheaths, and the woody portion below the growing point as well. At first the affected bud turned brown; later, due to fungus and bacterial action, rotting occurred, and a foul odor was produced. A distinct reddish or brown line was usually formed at the extremities of the disease in the older leaf sheaths, and in the woody tissue below the growing point. In advanced stages of infection the entire bud was killed and the tree died.

These symptoms produced with *Phytophthora faberi* Maubl. from cacao were identical with those observed in coconuts, on inspection trips in the field, thus indicating that a fungus was overlooked in the former isolation experiments. In order to ascertain whether a fungus was actually present in field cases, a typical specimen was secured from inspectors in the Bureau of Agriculture. Detailed microscopic examination of this diseased bud showed the presence of the mycelium of one of the Phycomycetes in the affected tissues, and of chlamydospores in the upper parts of the unfolded diseased leaves. Cultures were then conducted from various sections of the diseased tree with a view to isolating any fungi that might be present.

PHYTOPHTHORA FABERI MAUBL.: THE CAUSE OF BUD ROT

ISOLATION

On March 11, 1919, isolations were made from the typical case of bud rot sent to the writer by the Bureau of Agriculture. The tree was about 4 years old and was approximately 3 meters tall. Infection had apparently started from the tip of the young unfolded leaves, and had advanced downward into the young tender tissue of the growing point and into the woody parts below. The bud rot was a typical case, such as has been described in the section on general diagnosis. The tree was split lengthwise. The diseased portion was 2 meters in length extending from the tip of the young leaves to 20 centimeters below the growing point. Microscopic examination of the infected parts of the leaves, 60 centimeters above the growing point, showed the presence of mycelia and chlamydospores. Portions were cut from the affected parts with a sterile scalpel and placed on prepared corn meal plates. A *Phytophthora* was isolated from the woody tissue below the growing point, from the parts adjacent to the growing point, and from the leaf sheath 90 centimeters above. A microscopic examination of the fungus indicated that it was apparently the same as *Phytophthora faberi* Maubl. from cacao.

INFECTION STUDIES

With coconuts.—Infection studies were immediately carried out with this *Phytophthora*. For the first experiments seedling coconuts, from 75 centimeters to 2.5 meters in height, were used. The stab method of inoculation, described under bacterial work, was employed. Because of the extremely dry weather, all inoculated seedlings were placed in a damp chamber. Table III gives the results of the inoculations.

TABLE III.—*Inoculations with Phytophthorà faberi Maubl. obtained from coconut bud rot.*

No. of plant.	Date.	Condition of plant.	Observations.			Reisolation.
			Date.	Character.	Extent.	
					cm.	
1	March 21, 1919	Seedling, 75 cm. tall	April 1, 1919	Severe rot	4	+
2	do	do	do	do	9	+
3	do	do	do	do	10	
4	do	do	do	do	4	+
5	do	do	do	do	5	+
6	do	do	do	do	9	+
7	do	do	do	do	7	+
8	do	do	do	do	5	+
9	do	do	do	do	6	+
[a]10	do	do	do			
11	March 24, 1919	Seedling, 2.5 m. tall	do	Severe rot		+
12	do	do	do	do		+
13	do	do	do	do		+
14	do	do	do	do		+
[a]15	do	do	do			

[a] Control.

The tests showed that the thirteen inoculated seedlings were severely infected, while the two controls remained healthy. Thus all plants inoculated developed the disease. Evidence of infection could be observed one day after inoculation, because of a blackening of the tissues about the points of insertion. The controls, which were injured in the same way, and into which sterile water was introduced, remained perfectly healthy. The rapidity with which the organism attacks the tissues is shown by the fact that it advanced 10 centimeters in a period of ten days. Microscopic examination of the diseased portion showed in all cases the presence of the large, thin-walled, irregular, nonseptate, granular mycelium, characteristic of *Phytophthora faberi* Maubl. No bacteria had gained entrance at this early stage. Only a slight odor was evident, showing that the stench in older cases is produced by putrefying bacteria that follow the attacks of the fungus. In all cases reisolations were positive.

With other hosts.—In order to find out whether the fungus was omnivorous in its habits, and to determine whether it was similar, in this respect, to *Phytophthora faberi* Maubl. isolated from cacao, inoculations were made in fruits of cacao and papaya, and in seedlings of *Hevea* rubber. The cacao fruits were upon trees in the field, while those from papaya were placed

under bell jars in the laboratory. Table IV gives a summary of the inoculations.

TABLE IV.—*Inoculations on various hosts with Phytophthora faberi Maubl. isolated from coconut bud rot.*

No.	Date.	Character.	Observation.	
			Date.	Character.
CACAO-FRUIT INOCULATIONS.				
1	April 2, 1919	Injury; on tree	April 7, 1919	Slight infection.
2	do	do	do	Medium infection.
3	do	do	do	Slight infection.
4	do	do	do	Do.
[a]5	do	do	do	No infection.
PAPAYA-FRUIT INOCULATIONS.				
1	April 2, 1919	Injury, damp chamber	April 7, 1919	Severe rot.
[a]2	do	do	do	None.
HEVEA RUBBER. SEEDLING INOCULATIONS.				
1	April 3, 1919	Injury, damp chamber	April 7, 1919	Severe infection.
2	do	do	do	Do.
3	do	do	do	Do.
4	do	do	do	Slight infection.
[a]5	do	do	do	No infection.

[a] Control.

The inoculations clearly show that the fungus will cause a rot of cacao and papaya fruit, and a severe infection and the death of *Hevea* rubber seedlings. Since the same hosts are attacked by the strain of *Phytophthora faberi* Maubl. isolated from cacao fruits it can be stated, from the evidence furnished by cultural studies, that the organism from cacao is identical in this respect with the strain of *Phytophthora* isolated from coconut bud rot.

MORPHOLOGY OF PHYTOPHTHORA FABERI MAUBL. ISOLATED FROM COCONUT

GROWTH ON VARIOUS MEDIA

The fungus grows well on potato agar, oat meal agar, corn meal, and macerated young corn. A dense white, more or less felty growth, is produced on each. In the small number of tests thus far conducted the spore formation appeared to be slightly different on each medium. Chlamydospores are produced in

abundance by young cultures on oat meal agar, and conidia are only sparingly formed. In older cultures more conidia are produced. On corn meal the reverse was true in the preliminary tests. These tests also indicated that on potato agar and on macerated corn the chlamydospores appeared before the conidia.

MYCELIUM

The mycelium is white, producing a dense mass in pure culture. In young cultures it is nonseptate and granular. In older ones septa may be produced. Protoplasmic streaming is common. The submerged mycelium is more or less gnarled, while the aërial is straight. Branching is abundant. The width varies from about 3 to about 8 microns.

CONIDIOPHORES

Conodiophores are produced in great abundance in pure culture, especially on corn meal. Special culture methods must be employed in order to show them in their best condition. Material showing excellent conidiophore production may be obtained in sterilized Van Tieghem cells, by placing a few spores on a film of agar that has been put on the flamed cover slip. Each conidiophore may bear from one to fifteen or more conidia. A conidium is produced at the tip of a conidiophore; the latter then continues its growth by pushing the conidium to one side, and produces another conidium at its tip. By a continuation of this process a bunch of spores is finally formed. The conidiophores vary in size, ranging approximately from 180 to 645 microns in length and from 3 to 6 microns in width.

CONIDIA

The conidia are produced terminally as described above. They are elliptic to ovate, and possess very prominent raised terminal papillæ. These spores are pale yellow to colorless, and densely granular, usually having a large vacuole. Older conidia possess more granules that are in groups.

Measurements of conidia.—The measurements conform with those of *Phytophthora faberi* Maubl. as determined by Rosenbaum.(10) Measurements were made from two-day-old cultures on corn meal. The lengths and widths of two hundred spores were measured. The results are presented in Table V, which gives the class in microns and the number of conidia out of two hundred, both for length and width, that falls into each class.

TABLE V.—*Summary of measurements of conidia of Phytophthora faberi Maubl. from coconuts.*

[Corn meal cultures; age 2 days.]

Class.	Conidia in each class.	
	Length.	Width.
μ.		
19.5 to 21.49	0	0
21.5 to 23.49	0	1
23.5 to 25.49	0	11
25.5 to 27.49	0	2
27.5 to 29.49	2	29
29.5 to 31.49	1	23
31.5 to 33.49	5	68
33.5 to 35.49	0	27
35.5 to 37.49	8	32
37.5 to 39.49	4	4
39.5 to 41.49	23	3
41.5 to 43.49	14	0
43.5 to 45.49	25	0
45.5 to 47.49	11	0
47.5 to 49.49	21	0
49.5 to 51.49	6	0
51.5 to 53.49	26	0
53.5 to 55.49	5	0
55.5 to 57.49	19	0
57.5 to 59.49	4	0
59.5 to 61.49	11	0
61.5 to 63.49	4	0
63.5 to 65.49	4	0
65.5 to 67.49	5	0
67.5 to 69.49	2	0
69.5 to 71.49	0	0
Total	200	200

From Table V it can be readily seen that the conidia vary in length from 27.5 to 69.49 microns, and in width from 21.5 to 41.49 microns. In length the majority of the spores falls into the classes between 39.5 and 53.49 microns, the largest number falling in classes between 43.5 and 53.49 microns. In width the majority falls into classes between 27.5 and 37.49 microns, the largest number being in class 31.5 to 33.49 microns.

Table VI presents the arrangement in classes of the ratios of the length to the width of the conidia.

TABLE VI.—*Arrangement in classes of the ratio of the length to the width of the conidia, showing the limits of variation.*

[Corn meal cultures; age 2 days.]

Class.	Spores in each class.
85 to 0.94	0
95 to 1.04	1
1.05 to 1.14	6
1.15 to 1.24	11
1.25 to 1.34	36
1.35 to 1.44	40
1.45 to 1.54	28
1.55 to 1.64	24
1.65 to 1.74	23
1.75 to 1.84	11
1.85 to 1.94	13
1.95 to 2.04	5
2.05 to 2.14	1
2.15 to 2.24	0
2.25 to 2.34	1
2.35 to 2.44	0
Total	200

The class of ratio values into which the greatest number of conidia fell was 1.35 to 1.44. The mean ratio of length to width would thus have an approximate value of 1.4. These figures correspond closely with those obtained for *Phytophthora faberi* Maubl. by Rosenbaum.(10)

Germination of the conidia.—Germination takes place by the production of either germ tubes or swarm spores. Every conidium is potentially a sporangium; its method of germination is influenced greatly by its environment. Germination by germ tubes is by far the commoner method under cultural conditions. From one to five germ tubes may be produced; these apparently may develop from any part of the surface of the conidium. Up to the present time, no swarm-spore formation has been observed in the cultures obtained from coconut; but in those isolated from cacao germination by this method was frequently produced. During the first trials it was found impossible to obtain germination by swarm spores. In the months of February and March, at which time the nights are cool, swarm spores were produced abundantly in old cultures on macerated

corn. Swarm spores were readily obtained in Van Tieghem cells by growing the organism on very dilute agar or in hanging drops of water placed on sterile cover slips. Just before formation, there appears a rearrangement of the protoplasmic granules. The swarm spores are then produced within the sporangium. The papilla finally breaks off, and the spores escape. No vesicle formation has been observed. The spores near the opening escape one by one. Each rests for the period of a moment on the outside, and then swims off rapidly. As soon as a few spores have escaped, those remaining swim about actively within the sporangium and escape one at a time. The swarm spores are kidney-shaped. They swim about for a time by means of two flagella and then come to rest. At this stage they become spherical and may germinate after a few hours by the production of a germ tube.

CHLAMYDOSPORES

Chlamydospores are produced directly from the mycelium, usually terminally, but sometimes intercalarily. They are spherical, granular like the conidia, but with a slightly deeper yellow shade. In pure cultures they are produced in great abundance on oat meal or potato agar.

Measurements of chlamydospores.—The size of the chlamydospores is one of the criteria by which the species are separated. Two hundred measurements were made of the spores from cultures 3 to 10 days old on oat meal agar, and one hundred measurements of spores from cultures 6 and 7 days old on macerated corn. A summary of these measurements, grouped in classes, appears in Table VII.

The chlamydospores vary in diameter from 15.5 to 57.49 microns, the largest number falling in class 39.5 to 41.49 microns. The mean diameter is, therefore, more than 35 microns, being approximately 39 microns. These measurements correspond closely with those for *Phytophthora faberi* Maubl., found in the classification prepared by Rosenbaum.(10) There was little or no difference in size between the chlamydospores produced by the fungus growing on oat meal agar and those produced on macerated corn.

Germination of chlamydospores.—In Van Tieghem cells prepared with hanging drops of distilled water, corn meal extract, pure agar, or potato agar, direct germination will take place within twenty-four hours. From one to twelve germ tubes may arise from one spore.

TABLE VII.—*Summary of measurements of chlamydospores of Phytophthora faberi Maubl. from coconut bud rot.*

Class.	Chlamydospores in each class.	
	Oat meal culture; 3 to 10 days old.	Macerated corn culture; 6 to 7 days old.
μ.		
13.5 to 15.49	0	0
15.5 to 17.49	0	1
17.5 to 19.49	0	2
19.5 to 21.49	1	2
21.5 to 23.49	0	1
23.5 to 25.49	1	3
25.5 to 27.49	0	2
27.5 to 29.49	3	0
29.5 to 31.49	2	3
31.5 to 33.49	12	5
33.5 to 35.49	2	8
35.5 to 37.49	20	15
37.5 to 39.49	15	9
39.5 to 41.49	52	24
41.5 to 43.49	15	15
43.5 to 45.49	41	10
45.5 to 47.49	13	2
47.5 to 49.49	18	2
49.5 to 51.49	1	0
51.5 to 53.49	1	0
53.5 to 55.49	1	0
55.5 to 57.49	2	1
57.5 to 59.49	0	0
Total	200	105

SEXUAL BODIES

No sexual bodies have been observed in diseased portions of coconuts or in pure cultures. The absence of antheridia places the fungus at once in the *faberi* group, according to the classification of Rosenbaum.(10)

TAXONOMY

In determining the species isolated from coconut bud rot, the methods employed by Rosenbaum(10) have been followed. According to his key, which is given below, the fungus is included in the *faberi* group and is the species *Phytophthora faberi* Maubl.

AAA. Faberi group.—Antheridium entirely unknown or its relation to the oogonium not yet determined, chlamydospores absent or present. *P. faberi, P. jatrophae.*

B. Chlamydospores large, mean diameter more than 35 μ.

C. Mean diameter of chlamydospores 38.98 μ, mean ratio of length to width of conidia 1.47.....10. *P. faberi.*

BB. Chlamydospores small, mean diameter less than 35 μ.

C. Mean diameter of chlamydospores 32.89 μ, mean ratio of length to width of conidia 1.28....11. *P. jatrophae.*

SUMMARY

1. Enormous losses, amounting to thousands of pesos each year, are produced by coconut bud rot. As shown by the Bureau of Agriculture reports, the disease is most prevalent in Laguna, Tayabas, Pangasinan, and Zamboanga Provinces. It is most abundant in very humid sections and in thickly planted groves, both of which conditions are found on the slopes of Mount Banahao. Field studies show that the spread may be extremely rapid during favorable weather.

2. An organism similar to *Bacillus coli* (Escherich) Mig., and other saprophytic bacteria are associated with the disease. Under certain conditions, such as a host weakened by severe injury, the former organism and *Bacillus coli* (Escherich) Mig. isolated from man or horse, may in inoculation experiments produce disease.

3. A summary of the entire bacteriological work done by the present writer, including approximately three hundred inoculations, has indicated that, while the bacteria are always present and are a factor in destroying the weakened tissues, they cannot account for the initiation of the disease or its prevalence and rapid spread.

4. *Phytophthora faberi* Maubl. isolated from cacao produces a typical bud rot of coconut seedlings and of mature coconut trees.

5. A fungus isolated from a typical field case of coconut bud rot was found to be identical with the *Phytophthora faberi* Maubl. isolated from cacao.

6. *Phytophthora faberi* Maubl. isolated from the field case of coconut bud rot produced in all inoculated seedlings a typical infection.

7. *Phytophthora faberi* Maubl. isolated from the field case of coconut bud rot produced disease in coconut seedlings, cacao fruit, *Hevea* rubber seedlings, and papaya fruit. The same species of fungus isolated from cacao fruit produced disease in coconut seedlings and mature trees, cacao fruit and stem, *Hevea* rubber seedlings and mature trees, and papaya fruit.

8. A morphologic and taxonomic study of the organism isolated from coconut has proved that it is *Phytophthora faberi* Maubl., as described by Rosenbaum.(10)

9. From these researches it can be stated with certainty that *Phytophthora faberi* Maubl. causes coconut bud rot; bacteria are apparently, in the majority of cases, always secondary, but are concerned with destroying the weakened tissues.

10. By proving that the fungus causing coconut bud rot is identical with the organism which produces black rot of cacao pods, canker of cacao, fruit rot and canker of *Hevea* rubber, and rot of papaya fruit, it becomes evident an entirely new series of controls will have to be devised. *Phytophthora faberi* Maubl. may grow readily, under favorable conditions, as a saprophyte also, on dead portions of coconut, cacao, and papaya.

RECOMMENDATIONS

1. Trees when once severely infected never recover. The mode of growth of the palms and the nature of the disease make it impossible to cure trees already badly affected.

2. Systematic inspection, condemning and burning of all diseased coconut trees, as carried on by the Bureau of Agriculture, should be continued.

3. All parts of diseased trees must be burned; otherwise the organism will live as a saprophyte on dead matter, and then spread to healthy trees.

4. Clean cultivation ought to be practiced in all groves.

5. Under no circumstances should coconuts be interplanted with cacao or papayas.

6. If coconuts are planted near diseased *Hevea* rubber, precautions should be taken to avoid the spread of the disease.

7. Trees in new groves must be planted 10 meters apart each way. This spacing is one of the most satisfactory means of control against bud rot, and at the same time tends to give the highest production of nuts.

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ILLUSTRATIONS

[The plates are from a publication prepared by the writer on Philippine economic-plant diseases in the Philippine Journal of Science, Sec. A, 13 (1918) 192–274.]

PLATE I

FIG. 1. Coconut bud rot. Old infection. Entire central group of leaves killed and some fallen over.

2. Coconut bud rot. Central leaves killed and some fallen over. Outer older leaves healthy.

3. Coconut bud rot. Diseased central bud fallen over.

PLATE II

FIG. 1. Coconut bud rot. Young infection, showing unfolded tips of leaves newly diseased. From this point the disease advances downward into the growing point and more woody portion.

2. Coconut bud rot. Old infection. Entire "cabbage" and growing point softened.

3. Coconut bud rot. Old infection. Rotted portion just above growing point.

4. Coconut bud rot. Old infection. Characteristic brownish stripe, showing limits of infection in the wood.

5. Coconut bud rot. Disease produced in an injured seedling with a pure culture of bacteria similar to *Bacillus coli* (Escherich) Mig.

6. Coconut bud rot. Disease produced in an injured seedling with a pure culture of bacteria similar to *Bacillus coli* (Escherich) Mig.

PLATE III

Fig. 1. Coconut bud rot. Young infection. The fungus entered in young leaves at top. Note brownish line of demarcation at the limits of the advance in the woody parts.

2. Coconut bud rot. Young infection starting in at young unfolded leaves at top.

3. Coconut bud rot. Portion just below growing point in "cabbage" and young wood. Young infection.

Fig. 1.

Fig. 2.

Fig. 3.

PLATE I. COCONUT BUD ROT.

PLATE II. COCONUT BUD ROT.

Fig. 1.

Fig. 2.

Fig. 3.

PLATE III. COCONUT BUD ROT.

REVIEWS

Concerning some | Headaches and Eye Disorders | of Nasal Origin | by | Greenfield Sluder, M. D. | Clinical professor and director of the department of laryngology and rhinology, Washington University Medical School, | St. Louis. | St. Louis | C. V. Mosby Company | 1918. 272 pages, with 115 illustrations and index.

Impotence and Sterility | with | Aberrations of the Sexual Function | and | Sex-gland Implantation | By | G. Frank Lydston, M. D., D. C. L. | [3 lines of titles] | The Riverton Press | Chicago | 1917. 333 pages, illustrated. Cloth, $4.

Naval Hygiene | by | James Chambers Pryor, A. M., M. D. | medical inspector, United States Navy; master of arts in hygiene | Johns Hopkins University; head of department of hygiene, | U. S. Naval Medical School; professor of preventive | medicine, George Washington University | published with approval of the Surgeon General, U. S. Navy | and | by permission of the Navy Department | Philadelphia | P. Blakiston's Son & Co. | 1012 Walnut Street. Cloth, 507 pages, with 153 illustrations and index, $3 net.

Modern Chemistry and | Chemical Industry of | Starch and Cellulose | (with reference to India) | by | Tarini Charan Chaudhuri, M. A. | professor of chemistry, Krisnath College, Berhampore (Bengal); formerly | Government Research Scholar in chemistry; author of "Sir William | Ramsay as a Scientist and Man," etc. | Calcutta: Butterworth & Co. (India), Ltd., 6 Hastings St. | Winnipeg: Butterworth & Co. (Canada), Ltd. | Sydney: Butterworth & Co. (Australia), Ltd. | London: Butterworth & Co., Bell Yard, Temple Bar. | Medical Publishers | 1918 | All rights reserved. Pp. i–viii + 1–156, including index. Price, Rs. 3/12/-net.

Abstracts | of | Surgery | An abstract of the war literature of general | surgery that has been published since | the declaration of war in 1914 | prepared by the Division of Surgery, Surgeon- | General's Office | St. Louis | C. V. Mosby Company | 1918 | 434 pages. Cloth, $4.

As shown by the Preface, the "preparation of these abstracts, in common with many of the other early war activities, was an emergency war measure * * *. The volume must of necessity be regarded merely as a condensed text for ready reference. Most of the abstracts have been used through the courtesy of *Surgery, Gynecology* and *Obstetrics,* the *Journal of the American Medical Association,* the *Medical Record,* the *Military Surgeon,* and the *New York Medical Journal.* Some articles in the *British Medical Journal* and in *Surgery, Gynecology* and *Obstetrics* were so fundamental that they were abstracted with a minimal amount of paraphrase."

Genitourinary Diseases | and Syphilis | by | Henry H. Morton, M. D., F. A. C. S. | [10 lines of titles] | fourth edition, revised and enlarged | with 330 illustrations and 36 full-page colored plates | St. Louis | C. V. Mosby Company | 1918. Price, $7.

Issued with THE PHILIPPINE JOURNAL OF SCIENCE,
Vol. XIV, No. 1, January, 1919.

PROCEEDINGS OF THE MANILA MEDICAL SOCIETY

REGULAR MONTHLY MEETING, OCTOBER 7, 1918

MINUTES OF THE MANILA MEDICAL SOCIETY

The meeting was called to order at 8.40 p. m. in the Philippine General Hospital by President F. W. Vincent.

Twenty members were present. The minutes of the previous meeting were read and approved. Dr. Miguela Gemil was elected an active member of the society.

The following resolution, presented by Dr. R. B. Gibson, was adopted:

Whereas the National Guard of the Philippine Islands is urgently in need of medical officers at the present time.

Therefore, be it resolved that the Philippine Islands Medical Association and its component organization, the Manila Medical Society, in joint session, urge those available individual members thereof, who have not yet offered their services to the Guard, to at once apply for service with the Guard as a patriotic duty and for the honor of the medical profession of these Islands, and to use what personal influence they may command to persuade other medical men to this end.

The following papers from the surgical department of the College of Medicine and Surgery were read and freely discussed:

1. A Study of a Series of Cases of Splenectomy, by Dr. Potenciano Guázon.
2. Report of a Case of Schistosoma in the Appendix, by Dr. Potenciano Guázon.
3. Ureteral Obstruction, by Dr. José Eduque.
4. Demonstration of Some Important Cases of Fractures, by Dr. Ricardo Fernández.

There being no further business, the meeting adjourned.

D. DE LA PAZ,
Secretary-Treasurer,
Manila Medical Society.

SCIENTIFIC PROGRAM

A STUDY OF A SERIES OF CASES OF SPLENECTOMY

By DR. POTENCIANO GUÁZON

Several cases on whom splenectomy was performed by the department of surgery were described. The technic and special precautions to be observed were given in detail, and the post-operative treatment and prognosis were discussed.

A CASE OF SCHISTOSOMA IN THE APPENDIX

By Dr. Potenciano Guázon

Structures, seemingly schistosoma ova, were found in a section of an appendix. The possibility of the schistosoma as a causative factor in appendicitis is suggested.

URETERAL OBSTRUCTION

By Dr. José Eduque

Several cases of ureteral obstruction were reported. The diagnosis was made by Roentgen-ray photographs. Recoveries followed operation. The occurrence of this condition is commoner than may be supposed, and is characterized by acute attacks of pain which may be relieved when the patient is kept in bed for a few hours. Skiagrams illustrating the cases were exhibited by Dr. Ricardo Fernández.

A DEMONSTRATION OF SOME IMPORTANT CASES OF FRACTURES

By Dr. Ricardo Fernández

A demonstration of skiagrams of some complex cases of fractures was given.

R. B. Gibson,
Editor of the Proceedings,
Manila Medical Society.

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PROCEEDINGS OF THE MANILA MEDICAL SOCIETY

REGULAR MONTHLY MEETING, NOVEMBER 4, 1918

MINUTES OF THE MANILA MEDICAL SOCIETY

The meeting was called to order at the Philippine General Hospital at 8.45 p. m. by Doctor Gibson, in the absence of the officers and councillors.

On motion, duly seconded and carried, Doctor Schöbl took the chair. Doctor Gibson acted as Secretary pro tempore. Twelve members and six guests were present. The minutes of the preceding meeting were not read.

The following scientific program was presented, and the papers were read, with the exception of that of Doctor Gonzalez who was not present:

1. Clinical Observations on 178 Cases of Dysentery, by Drs. J. Albert and J. Tirona. Discussion by Dr. H. W. Wade.
2. A Case of the Pseudomeningitic Form of Infantile Beriberi, by Dr. T. C. Arvisú.
3. A Case of Subcutaneous Emphysema Complicating Acute Bronchopnèumonia, by Dr. Alberto Tupas.
4. Coöperation between Hospital Ward, Dispensary, and Social Service Department, by Dr. J. Gonzalez. Discussion by Dr. J. Fabella.
5. Demonstration of Skiagrams of Beriberi Heart in Children, by Dr. R. Fernández.

The meeting was adjourned at 10.55.

R. B. GIBSON,
Secretary pro tempore,
Manila Medical Society.

SCIENTIFIC PROGRAM

CLINICAL OBSERVATION ON 178 CASES OF DYSENTERY

By DRS. JOSÉ ALBERT and J. TIRONA

The records of the department of pediatrics for the last two years show a mortality of 54 per cent in the dysentery cases entered, thus making it the most serious type of cases which the pediatrics staff encounters. The incidence and virulence of the infections is increased during the rainy season. The largest number of cases occurred in children under 2 years of age, and the next highest in those under 5 years; of seventy-three cases

under 2 years of age, twenty-four were infants less than a year old (one case only 6 days old). Almost 50 per cent of the children of 5 years or younger died with pulmonary complications. The usual period of the disease is from three weeks to two months. Five cases had a history of previous or existing cases of dysentery in the family. Bacteriological examinations of the stools for *B. dysenteriæ* were rather unsatisfactory, negative reports being received for many cases clinically dysenteric. Five cases were positive for *Entamœba histolytica*. Twenty-eight cases were heavily infected with ascaris, ten had trichuriasis, and eight had a double infection with these parasites. There was one case each of anchylostomiasis, oxyuriasis, and blastomycosis, and two having trichomonas. Four cases were complicated with paratyphoid, and one was positive for both paratyphoid and typhoid infections as shown by blood cultures. Treatment is partly symptomatic; purgatives and saline colonic irrigations are given also when acute toxæmia is present, and intramuscular or intravenous injections of antidysenteric serum are administered, when available, to the severe cases.

A CASE OF THE PSEUDOMENINGITIC FORM OF INFANTILE BERIBERI

By Dr. T. C. Arvisú

Pseudomeningitic cases of beriberi in infants have recently been reported to this society by Doctor Albert. Another case, 6 months old, is presented. Symptoms were slight fever, drowsiness, vomiting, cyanosis, convulsions, no crying, and ptosis. Skiagrams showed an enlarged right heart. Improvement and recovery followed treatment with vitamine preparations (tikitiki extract), which is confirmatory of the diagnosis.

DEMONSTRATIONS OF SKIAGRAMS OF BERIBERI HEART IN CHILDREN

By Dr. Ricardo Fernández

The method of determining the size of the heart from skiagrams was described. Plates exhibited demonstrated the hypertrophy in beriberi cases.

R. B. Gibson,
Editor of the Proceedings,
Manila Medical Society.

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PROCEEDINGS OF THE MANILA MEDICAL SOCIETY

REGULAR MONTHLY MEETING, DECEMBER 2, 1918

MINUTES OF THE MANILA MEDICAL SOCIETY

The meeting was called to order at 8.40 p. m. in the Philippine General Hospital.

President F. W. Vincent and nine members were present.

The minutes of the October and November meetings were read and approved. Drs. Pedro T. Lantin and Alva D. Cook were elected active members in the society. The society approved a plan to hold a symposium on the present epidemic of influenza at the coming annual meeting.

The following program was presented, and the papers were read and discussed:

1. Cataract Cases and Operations, by Dr. A. R. Ubaldo.
2. Unusual Complication after Grattage of the Lids for Trachoma, by Dr. A. R. Ubaldo.
3. Mastoid Operations, by Dr. H. E. Velarde.
4. Cases of Tonsillitis in the Dispensary of the Philippine General Hospital, by Dr. F. Nicolas.
5. Teratoma of the Maxillary Antrum, by Dr. H. E. Velarde.
6. Skiagrams of Cases from the Department of Eye, Ear, Nose, and Throat, by Dr. R. Fernández.

The meeting was adjourned at 10.50 p. m.

D. DE LA PAZ,
Secretary-Treasurer,
Manila Medical Society.

CATARACT CASES AND OPERATIONS

By DR. A. R. UBALDO

Fifty operations for cataract included twelve cases of double cataract, one congenital, one with a dislocated lens, and three traumatic. The ages of the patients varied from 4 to 90 years. The methods employed, including the advantages of a preliminary iridectomy, combined removal of the iris and lens, or extraction of the lens alone, were presented. In one case of double cataract, one eye was operated with iridectomy, the other sub-

sequently without; vision after the recovery was 20/80 and 20/40, respectively. The author favors the upper corneal section. Postoperative treatment, complications, and accidents were generally discussed; prolapse of the iris with iritis was the most frequent postoperative complication in the series of cases.

AN UNUSUAL COMPLICATION AFTER GRATTAGE OF THE LIDS FOR TRACHOMA

By Dr. A. R. Ubaldo

A female patient, 26 years old, had trachoma for three years. Three weeks before operation the condition became more acute. Examination showed the upper fornix of the right eye covered with granulations. Three hours after operation (with local anæsthesia, using cocaine powder) the patient complained of severe pain in both eyes. Treatment consisted of ice compresses, morphine, bromides, and aspirin. The following day the patient had severe pain in the right eye; the lids were swollen and were opened with a retractor. An unusual keratitis with peculiar striations was observed. Both eyes were affected. There was no ciliary injection and no tension of the eyeball. On the third day pain continued in the right eye. Atropine dilated the left iris only. An œdematous condition of the nimbus (sclero-corneal union) with beginning suppuration was observed. The condition lasted from two to three weeks. The right eye became entirely blind.

MASTOID OPERATIONS

By Dr. H. E. Velarde

The writer reviewed the common operative procedures and postoperative treatment. Of eighty-five cases considered, sixty recovered, eleven improved, four did not improve, five died, and five were discharged, results comparing favorably with statistics from other hospitals.

TONSILLITIS

By Dr. F. Nicolas

The etiology, character, treatment, and complications were discussed for the acute and chronic cases. The commonest forms of tonsillitis treated were the acute catarrhal and follicular types. The condition is most common in males, in patients from 14 to 25 years of age, and it occurs most frequently in July and August.

TERATOMA OF THE MAXILLARY ANTRUM

By Dr. H. E. Velarde

The case described was that of a 14-year-old girl. The condition was of several years' standing, there being an increasing prominence of the right face. The right maxilla in the region of the antrum of Highmore was found to be prominent and bulging, extending to the side of the nose. There was no inflammation nor was there tenderness on pressure. A skiagram showed the presence of a tooth in the antrum. A radical operation was performed, the antrum being opened by a blow on a chisel, the membranous sac (containing fluid) was incised, and the sac and the single rooted tooth buried in the roof of the antrum and floor of the orbit were removed. An opening into the nose was left for drainage. The pathological examination indicated that the tumor mass was of the nature of an enamel organ or adamantinoma. The location is unusual.

SKIAGRAMS OF CASES FROM THE DEPARTMENT OF EYE, EAR, NOSE, AND THROAT

By Dr. Ricardo Fernández

An instructive series of plates was presented showing the locations of coins in the œsophagus and lower tract, seeds (coated with bismuth subnitrate) in the intestine, an automobile (cracker) in the œsophagus, three cases of foreign bodies in the eye which were located by double exposures with the eyes directed first to the right and then to the left, a shot in the orbit, and sinus and mastoid infections.

R. B. Gibson,
Editor of the Proceedings,
Manila Medical Society.